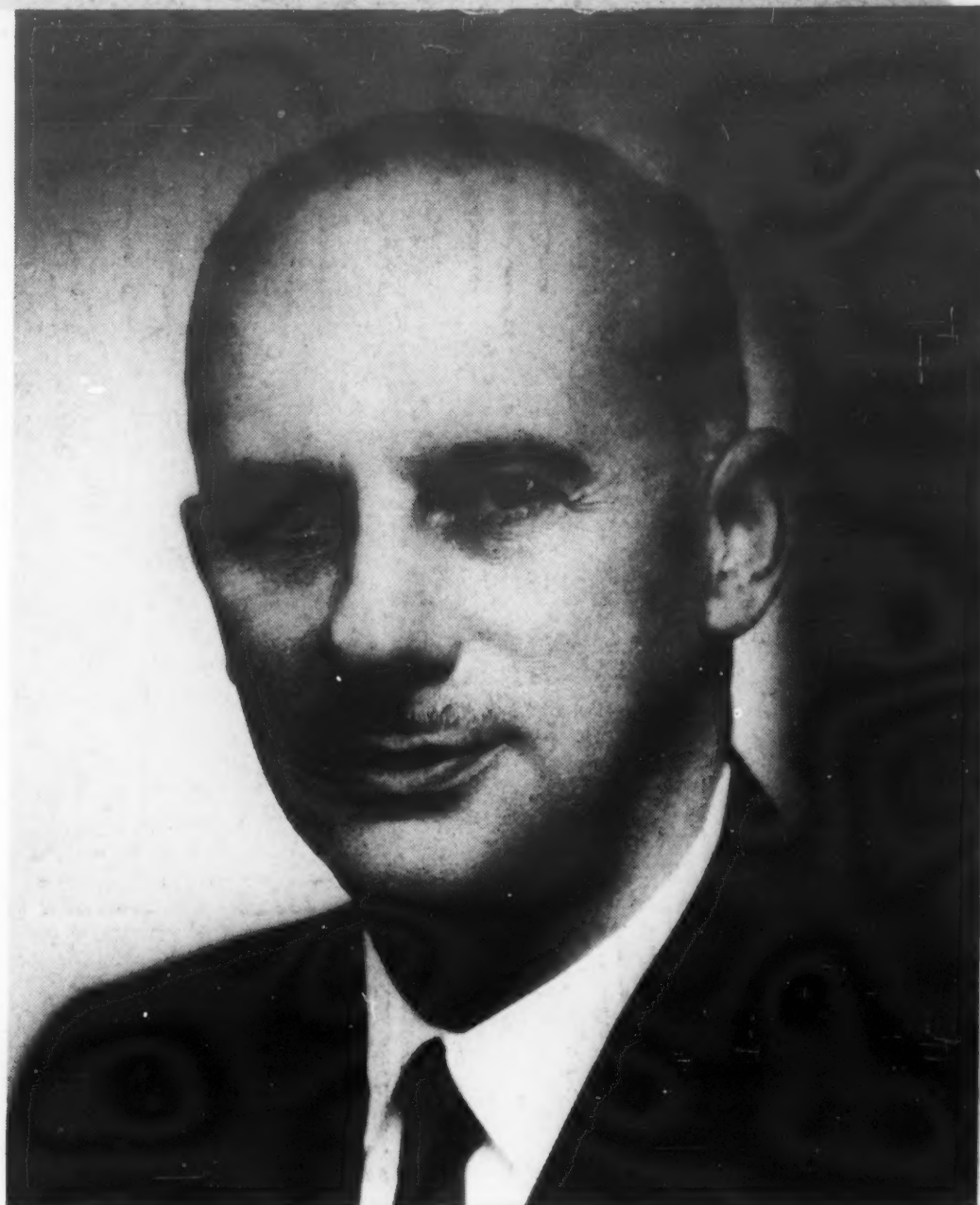




FRANK A. GUNTHER
*National President, AFCEA
President, Radio Engineering
Laboratories, Inc.*



SIGNAL

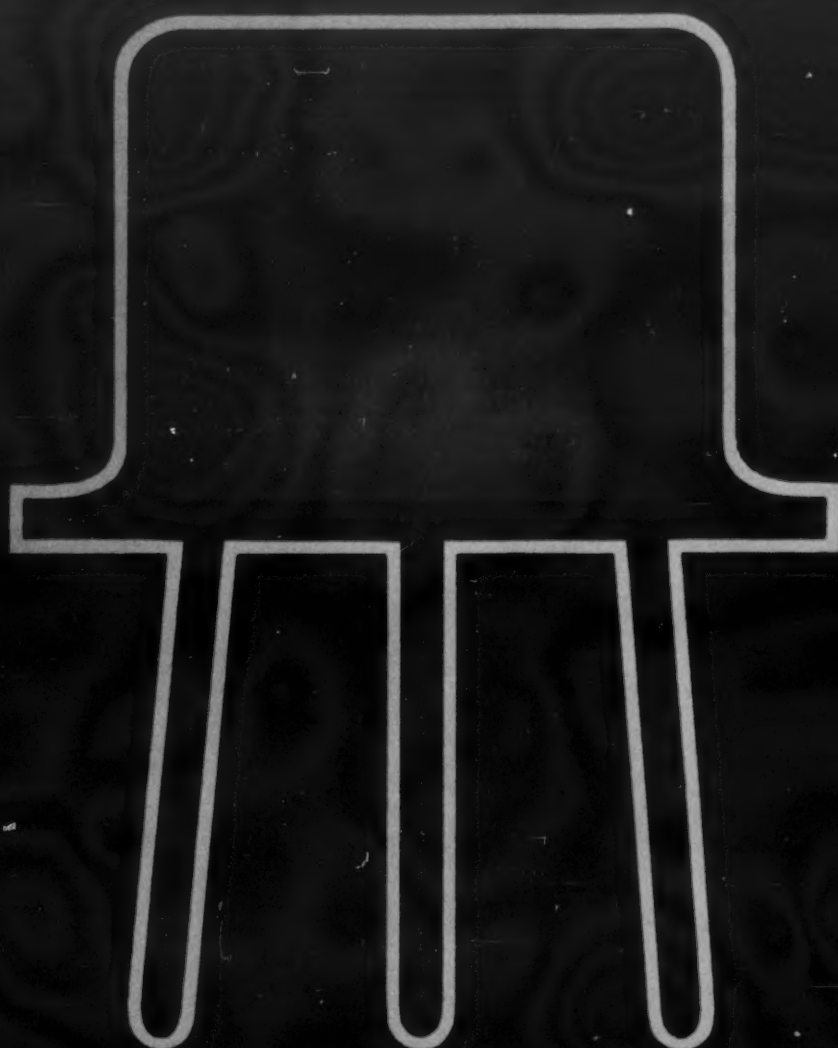
15TH ANNUAL AFCEA CONVENTION REPORT—PART 1



B. H. OLIVER, JR.
*Immediate Past President, AFCEA
Vice President Upstate
New York Telephone Company*

August 1961

PHILCO EPITAXIAL SILICON MESA



FIRST TO COMBINE

120 V (BV_{CBO})

0.5 V(SAT)

150 mc. f_T

**2N2087 NPN
CORE DRIVER
LINE DRIVER**



TO-5

ABSOLUTE MAXIMUM RATINGS

Storage Temperature -65 to +300°C.
 BV_{CER} ($R \leq 10\Omega$) 80 volts
 BV_{CBO} 120 volts
 BV_{EBO} 5 volts
Collector Current I_C 500 ma
Total Device Dissipation (case 25°C.) 2 watts
Total Device Dissipation (case 100°C.) ... 1 watt
Total Device Dissipation (free air 25°C.) 0.6 watt

ELECTRICAL CHARACTERISTICS (@ 25°C.)

Characteristics	Conditions	Min.	Max.	
h_{FE}	$V_{CE} = 1V.$ $I_C = 150 \text{ ma.}$	40	120	
V_{BE}	$I_C = 150 \text{ ma.}$ $I_B = 15 \text{ ma.}$		1.2	volts
$V_{CE}(SAT)$	$I_C = 150 \text{ ma.}$ $I_B = 15 \text{ ma.}$		0.5	volts
f_T	$I_C = 50 \text{ ma.}$ $V_{CE} = 10V.$	150		mc
C_{ob}	$V_{CE} = 10V.$ $I_E = 0 \text{ ma.}$		12	pf
I_{CBO}	$V_C = 60V.$ $T = 25^\circ C.$		2	μa
I_{CBO}	$V_C = 60V.$ $T = 150^\circ C.$		200	μa
BV_{CER}	$R \leq 10\Omega$ $I_C = 20 \text{ ma.}$ pulsed	80		volts
t_r			85	nsec
t_s			100	nsec
t_f			55	nsec

You would expect Philco, as inventor of industry's most capable germanium logic transistor—the MADT, to design Silicon memory components with extra capability, too. And Philco has done it. The 2N2087, forerunner of a broad line of Philco epitaxial silicon mesa transistors, offers an incomparable combination of parameters that may well be the special design solution you require: maximum BV_{CBO} of 120 V., minimum h_{FE} of 40 at 1V_{CE}, maximum V_{CE} (SAT) of 0.5 V., minimum f_T of 150 mc., maximum C_{ob} of 12 pf., and maximum t_s of 100 nanoseconds.

The new Philco 2N2087 epitaxial silicon mesa delivers optimum drive for computer memory planes, serves as a medium power switch in airborne controls systems, and is ideally suited to a wide variety of other applications such as small power supplies, servo amplifiers, and automation controls. For complete information, write Dept. S861.

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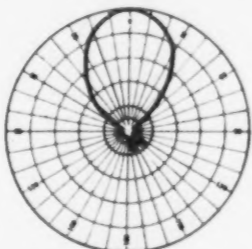
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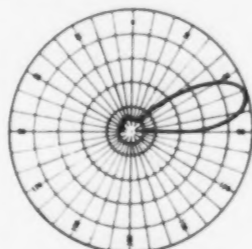


FOR MEDIUM-HAUL HF CIRCUITS: ANOTHER LOG-PERIODIC

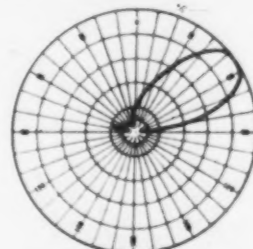
antenna from Granger Associates—now in production *and in service*. This horizontally polarized transposed dipole type offers a gain of 13.5 db at a take-off angle of 23 degrees over the 5 to 30 Mc band. Take-off angle is constant as frequency is varied. VSWR is 2:1 (nominal). Since it uses no terminating resistors, its efficiency is considerably greater than that of a rhombic. The practical result for medium-haul point-to-point h-f circuits: radiation of maximum useable power in the optimum elevation and azimuthal directions. / This antenna, G/A Model 748-23, is but one of a series of broad-band directive antennas



Azimuth Plane Radiation
Pattern of Granger
Associates Model 748



Elevation Plane Radiation
Pattern of Granger
Associates Model 748-23



Elevation Plane Radiation
Pattern of Granger
Associates Model 748-35

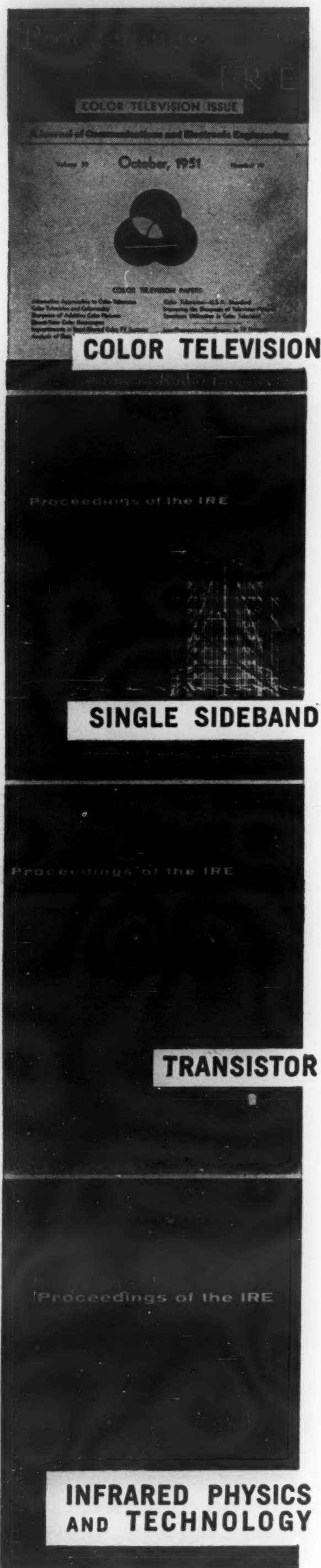
(the illustrations also show a typical elevation plane radiation pattern for G/A Model 748-35). Choice among the several models is properly made by analyzing the particular circuits involved. A new Granger Associates staff study will give you considerable assistance in this task; and it also describes G/A's vertically polarized omni-directional antennas, balun transformers, and transmitting or receiving multicouplers. For your copy, write or wire the world's leading supplier of log-periodic antennas for h-f communications:

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SPECIAL ANNOUNCEMENT

Part II of the Convention proceedings will appear in the September issue of SIGNAL.

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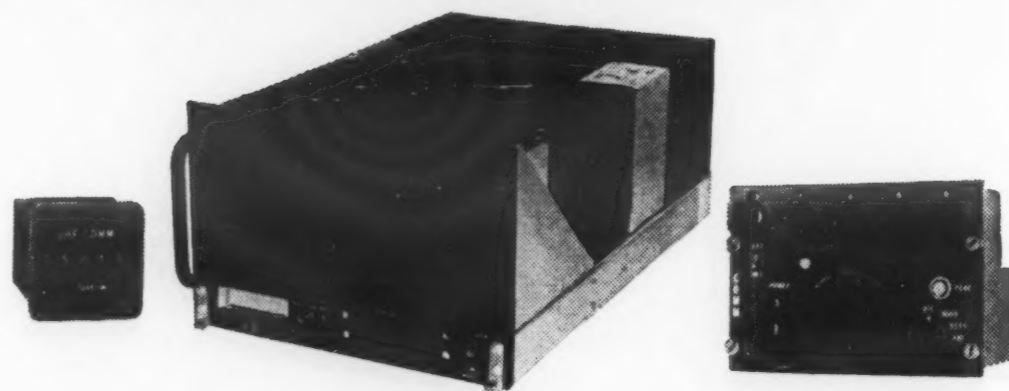


Magnavox continues to maintain a position of leadership in the airborne communications field.

Magnavox engineering, in conjunction with the Air Force, has developed an advanced airborne communication system that is designed to meet the requirements of the future. Utilizing wide band techniques, such functions as television relay for bomb damage assessment, data link for control and identification, and many other forms of air-to-air and air-to-ground communications can all be realized over the same equipment as used for voice.

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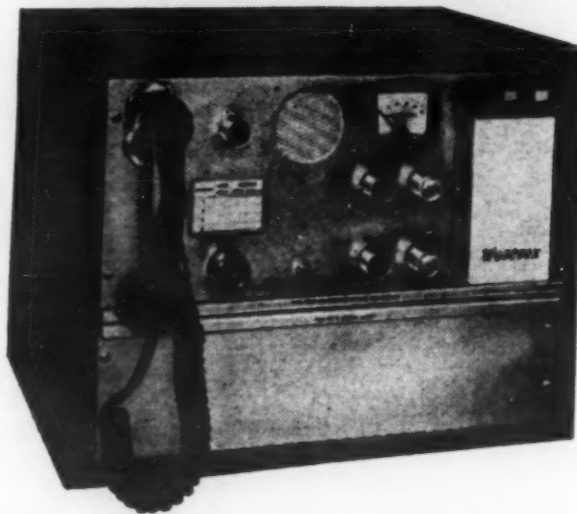
265,000-HOUR OBSESSION

Give or take a few hours, 265,000 hours amounts to about 30 years. That's the length of time Westrex, one of the pioneers in high frequency single-sideband systems, has been concentrating on the development and manufacture of communications equipment. The new Westrex Type 9B HF SSB Transmitter-Receiver is the latest result of our single-minded effort to design a low-cost, medium-range unit that can be relied upon for sound, uniform operation.

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A TRIBUTE

IT WAS with a feeling of deep pride and grateful acknowledgment for a job well done that the National Council at the 1961 Annual Convention voted unanimously to record the Association's sincere thanks, warm appreciation and admiration for a man who has served so outstandingly for the past two years as AFCEA's National President.

Benjamin H. Oliver, Jr. in accepting the challenge of this most important position in 1959 did so with the strong conviction that AFCEA could move forward to its greatest height by 1961, the eve of its 15th Anniversary. This objective actually became a positive reality under Mr. Oliver's direction and guidance as evidenced by the progressive growth in every phase of the Association's activities.

This remarkable success didn't just happen. More precisely, it is very definitely attributable to the dynamic executive leadership, enthusiastic desire, and the imaginative thinking which is so strikingly inherent in Ben Oliver's make-up.

All AFCEA knows the many extra hours of service that Mr. Oliver gave so willingly to the Association and how seriously, but gladly, he accepted the full responsibility of his office. To the entire membership he has been a tower of strength, a respected leader, gentleman, and true friend. We owe him much.

FRANK A. GUNTHER
National President, AFCEA
President, Radio Engineering
Laboratories, Inc.



A WELCOME

IN DECEMBER 1960, Mr. Gunther became President of Radio Engineering Laboratories, Inc., Long Island City, N. Y., communications subsidiary of Dynamics Corporation of America and the leading producer of tropospheric scatter radio equipment. Prior to his selection as President, he had served with distinction as Executive Vice President and General Manager of REL since July 1959. Mr. Gunther joined REL in 1925, and became vice president in 1929. He is a pioneer in advanced communications engineering and is noted for being instrumental in the development of the world's first two-way mobile radio, very high frequency two-way aircraft installation, VHF radio-teletype, FM broadcast equipment, mass-produced FM receivers for professional use, Loran transmitters, and, in recent years, tropospheric scatter equipment.

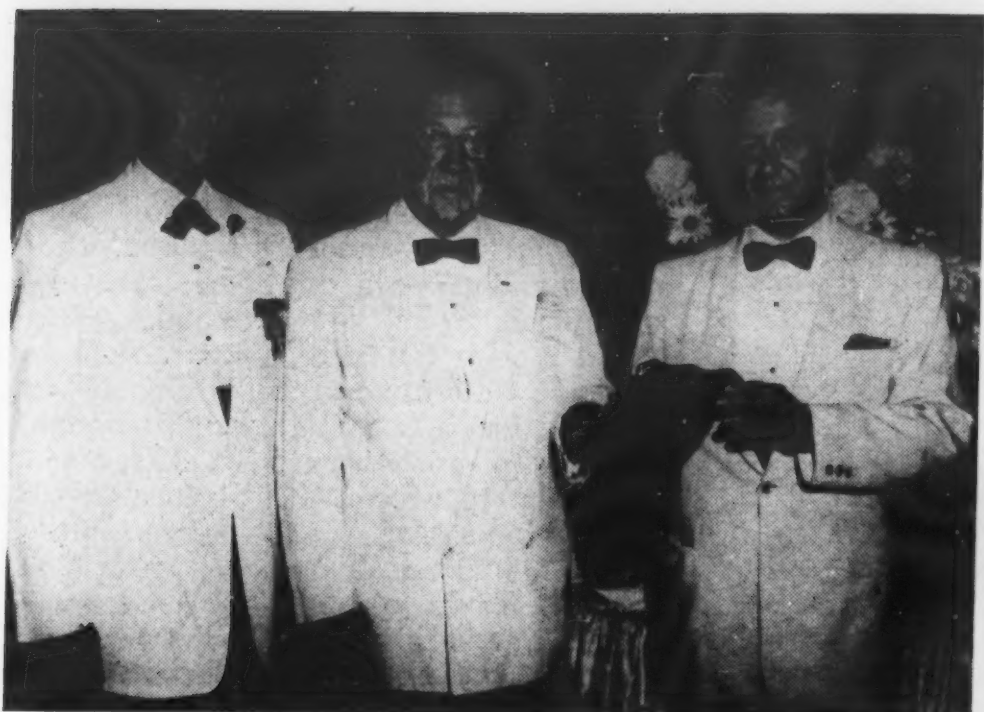
It is a privilege to introduce Frank A. Gunther as the new National President of the Armed Forces Communications and Electronics Association. Mr. Gunther is a lifelong amateur radio enthusiast operating under the call letters W2ALS. He is a past president and director of the Radio Club of America, an honorary director of the Single Sideband Amateur Radio Association, a member of the Quarter Century Wireless Association and of the Veteran Wireless Operators Association, a member of the American Radio Relay League and a senior member of the Institute of Radio Engineers.

Being an avid sportsman, he ranks ham radio and boating as tops on his list for enjoyment whenever his business schedule will permit.

All of AFCEA is honored to say welcome aboard.



Some of the Annual Banquet Guests



OPENING CEREMONY REMARKS



by

BENJAMIN H. OLIVER, JR.
Retiring AFCEA National President

IN RECENT YEARS it has been our custom to feature a new scientific development in the communications-electronics-photographic field at the opening ceremonies of AFCEA. You are about to see a demonstration of a communication breakthrough which potentially can affect the very uses to which communication channels are placed.

All of us have worried about our limited radio frequency spectrum. We knew that light waves and radio waves were quite similar and both were electromagnetic in character. However, we could not control light waves because we could not tune them. We said that light was non-coherent, and that radio waves were coherent. Furthermore, we did not know how to make light waves coherent.

Then Dr. Schawlow of the Bell Laboratories and Professor Townes of Columbia University discovered the principle of the optical maser which made coherent light possible. Coherent light moves in phase like a troop of disciplined soldiers. It can be controlled, directed and made to carry information over great distances. The entire span of our present radio frequency spectrum amounts to only 1/100 of 1 percent of the amount available to us in the span of coherent light. Herein lies the key to the growth of communication channels that we will need in the future, communication channels which may be multiplied perhaps 10,000 times.

The name maser came from the initial letters of the words Microwave Amplification by Stimulated Emission of Radiation. Up to now an optical ruby maser only generates coherent light intermittently, and it requires great amounts of power to do so. However, there is an optical maser that generates a steady supply of coherent light. It was recently invented by Dr. Javan, Dr.

Bennett and D. R. Herriott of the Bell Laboratories.

This newer gas optical maser is a glass tube about 40 inches long, filled with a mixture of helium and neon in the ratio of 10 to 1. The ends of the tube are partially reflecting flat parallel mirrors. A 50-watt generator supplies the outside power to drive the gas electrons to higher energy levels. Most of the radio-frequency energy is coupled to the helium electrons. As the helium electrons collide with neon electrons, the energy is transferred to the neon electrons. This pumps the neon atoms to higher energy levels and prepares them to emit this energy as coherent light when stimulated.

The emission from the gas optical maser is more directional, and has more sharply defined frequency than the ruby optical maser. The beam from the gas-type optical maser is about 100,000 times narrower in frequency than that of the ruby type—and the ruby optical maser's beam is 100 times narrower than that of other light sources.

Until the optical maser was invented, communication systems using coherent waves were limited to radio frequencies. The optical maser will increase "carrier frequency" to the visible light range thus increasing available communications channels. To appreciate the significance of this tremendous new frequency span, you need only realize that a color television channel requires a bandwidth of nearly 10 million cycles. If the entire existing radio frequency spectrum were used in a 10 percent modulation system, about 100 color television channels would be available. This would be adequate for television, but it leaves no space for data transmission and telephony. The maser beam could handle 100 color television channels and still have enough space for everything else.

Some of the possibilities for the optical maser include applications in radar; in earth-to-satellite, satellite-to-earth and earth-to-moon links; in chemistry and medicine. We are now going to demonstrate a model of a continuously operating optical maser. The maser is now being aimed at our moon model in the hall. The music you hear is being transmitted over a modulated light wave from the model of a gas optical maser to the moon to your right.

Now I'm going to flash a beam from a ruby-type optical maser onto a silver ball on top of what looks like a flagpole. The silver ball is connected to a receiver equipped with a tuned filter that allows it to react only to a powerful, narrow, highly directional beam of light—that is coherent light. Keep your eyes on the ball and the white ribbon strung across the entrance to the convention hall. [Ed. note: On signal and at the proper moment the ribbon was cut, the silver ball opened and an American flag was unfurled.]

You can see that the optical maser's pulse went through the filter quickly because there was enough strength in that thin coherent beam to trip the photoelectric cell inside the receiver.

Those of you who wish to see any of this equipment at close hand will be able to do so by visiting the Bell System exhibit.

I now declare that the 15th Annual AFCEA Convention is officially opened and invite you to enjoy its proceedings.

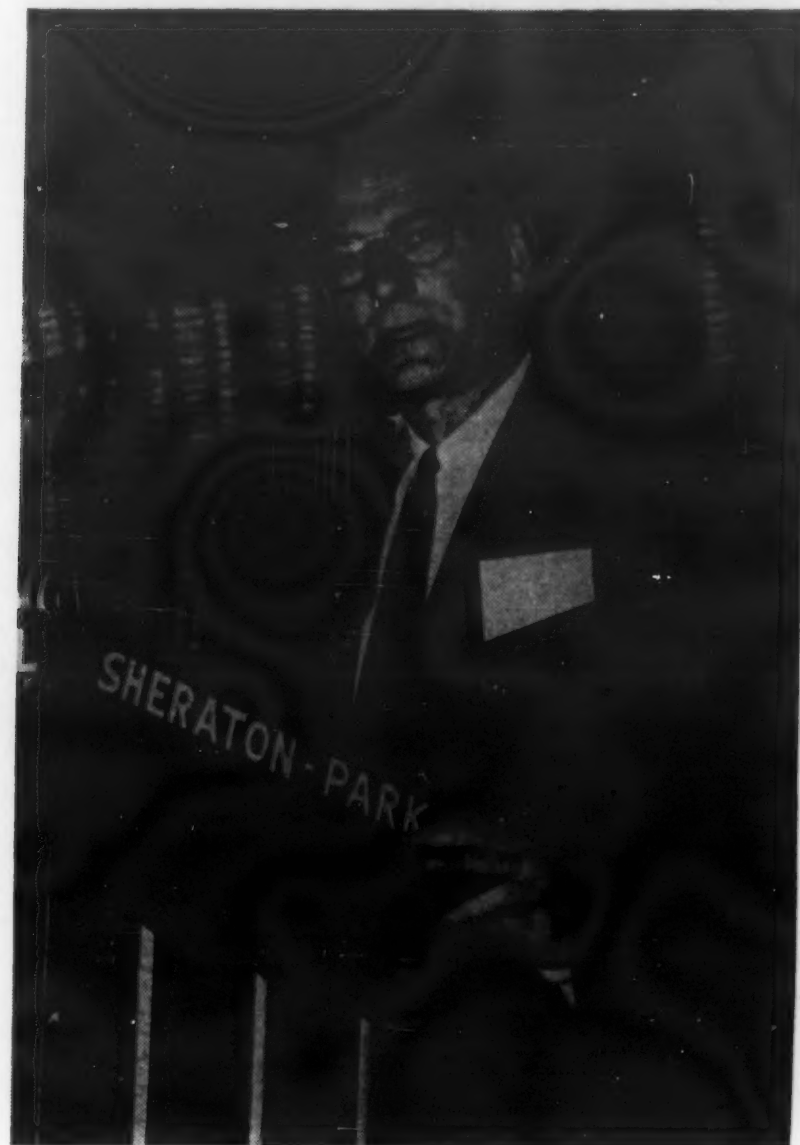


A study in concentration at the optical maser opening ceremony

KEYNOTE LUNCHEON ADDRESS

by

RICHARD S. MORSE
Former Assistant Secretary of the Army
(Research and Development)



I AM VERY GLAD TO be here today. If I were to look back on my research or personal career in the last 25 years when I went into industry, I would find my interest has certainly been more in communications than any other single thing.

Today I would like to speak, if I may, as an old frontiersman who's also been a new frontiersman, who has recently left Washington, and just give you a few thoughts. And you can take them as such.

I think it's perfectly clear to all of us in the technical field that research is here to stay. When I got out of M.I.T. in 1933, the total research and development expenditures of this country (and I'm speaking now of Government and Industry) was \$200 million a year.

My little personal budget the last two years in the Pentagon has been about one billion, one hundred fifty million dollars. I would just like to call that to your attention. That is what has happened since I got out of school.

It is perfectly obvious that both this country and the U.S.S.R. are relying as never before upon research or technology or whatever term you wish to use as a medium for war, as a medium for preserving the peace and as a medium—and I think one which will become increasingly apparent—of getting into commercial business to compete in the world market.

I would like to call your attention to one other factor in research today that is not so simple. The small companies are having a rough time. It is going to be worse, I think, rather than better. But more important in terms of national planning, the time scales associated with our R&D methods as well as the dollars are very, very long. The kinds of things which we are trying to do in defense today, the big ones and the important ones, the ones that get in the press, are six, eight, ten years in length.

And I think this is something which we have got to realize—the public certainly doesn't. You just don't go out and spend more money to increase the budget—push a button and somehow solve a Saturn problem or an

Atlas problem. We are going to have to look at this R&D effort in an entirely different perspective if we are going to get on with the job.

Soviet Approach vs. Free Enterprise

Now how does the U.S.S.R. approach this? The U.S.S.R. rightly or wrongly does have a highly centralized organization. They have recognized early the need for more scientists and more engineers. They recognized it very early and they tend to have a single, centralized plan, a single, centralized effort. The Russian Academy of Science is the central theme, and in their defense effort they tend to have a single service (that is a dirty word, I know, to you—and I am not sure it is the answer). I am just reviewing how they go about it.

But fundamental to everything they do, it seems to me, unfortunately, is a concept of working for an ideal. Maybe it is the wrong ideal, but they at least have more of a national objective, philosophically, more of a national objective in terms of organization. And the common denominator: they have always thought in terms of 5-year plans.

Now what do we do? We have, I am afraid, essentially a splintered approach to our research and development efforts. And part of this is probably very appropriate. We believe in a free enterprise system. And it is up to us here in this room to try to make it go.

But a free enterprise system, by definition, is one which is splintered. We believe in competition. It is the thing that has made this country great, but it does create some problems. We in the free world have a splintered, unorganized, competitive system. Our NATO countries are competing for business, the same time that they are trying to work cooperatively in a unified military effort.

Every country in the free world is trying to work as best it can with the United States against the U.S.R.R., but at the same time and in the background is the realistic problem of earning a living in their version of a free

enterprise system. This is what makes our problem doubly difficult.

In the Defense Department we have three services—and we do compete among the three. The concept of keeping three services was based on the premise that three heads are better than one. And each of us in the three services would stand to show this side of a problem or that side to the over-all good of the Defense Department effort.

We have heard a lot recently about space. If you want to look back historically, we were certainly splintered when Sputnik I went up. We had three services, each of whom felt they could put up a satellite. I am not quite sure I know why, but this is the way we went about it. We had endless arguments as to who had the best competence. I think in reality any one of the three services might have done the job. Within the Army, I am sure many of you remember the Von Braun-NASA hassle and I am ashamed to say that this particular hassle was not really geared to a great national approach as to "how can the country do the job best?" It was geared to "this faction versus that faction," which again was indicative of the splintered problem we have—one which concerns me greatly.

We have industry, and under our free enterprise system we have a desire, and a very appropriate one, to make money. This is the way this country grew. This is the system we have got to preserve and fight for. But if you really want to be honest and face reality, we have more facilities today in industry than we know what to do with. You might just as well admit it. We have industry competing with industry, the theory being that out of this we will get the best approach to a given problem. I hope we will; we are going to have to.

Political Considerations

But, again, we are on the defensive in terms of most effective utilization of the best people we have. Politically we have two parties and this is good. This country was founded on the two party system. It is a real backbone of democracy. But suddenly you have a transition. I have just been through one and it has been very, very interesting. Suddenly we have essentially cleaned out the Pentagon. I think there were only four of us that stayed on at the Assistant Secretary level. We have a good group and I do not mean to be critical. We have the smartest group that we have had in a long time down here. They are eager, aggressive, talented, highly intellectual. But, again, we split the country in two in the sense of our ability to call upon the best people to get on the job.

We have the old local interest problem. I am not trying to be a pessimist; I am just trying to face reality. We are tending, again and again, to place contracts to solve unemployment. That is a hard way to get talent. In general, you don't find the best talent in an area where there is unemployment. But this again is a part of our democratic system, and to my mind a very serious handicap in our attempt to use the best abilities we have in the United States to meet the U.S.S.R. problem with which we are all so concerned.

Our very system of competitive bidding is terrible. The amount of talent, the amount of effort, that you people use in putting in proposals—and you are going to have to use your best people if you are going to do a good job—is certainly very wasteful. But this is part, again, of the democratic system of making sure that everybody has a free chance to get in and make some money. It is a splendid non-organized approach in order that we can be sure that we have competition.

The press is a problem. I don't think anyone needs to be reminded of that. We have a great press in this country, but, again, every newspaper in the United States is out to sell newspapers to make money. You don't make any money by writing on the front page about a happy marriage. It doesn't sell. As a result, the primary kind of news that makes sense in this country today is controversial. When a newspaperman writes about the controversy or shows that an Atlas fails or that a Redstone fails, this gets on the front page. You don't hear much about the successes in this country, and we have had a lot of them, particularly in the military area. But this is something that we in Washington fight continuously. I think it is about time the American public woke up to the fact that we have some good people down here. We have got to stop writing front page stories about things that are wrong, half truths, innuendos, just to sell newspapers. This, again, is part of our splintered competitive society which we in America are trying to preserve.

I suppose I may sound critical here; I don't mean to be. I am just trying to give you a brief summary of what I have seen in two years in Washington—two years which I have enjoyed very much, two years which have been very stimulating. But I think these are fundamental problems to which we, as Americans, must direct our efforts for the next few years if we are to get on with a very difficult job. It is not getting easier. In my opinion, we are losing ground every day.

A Time for Initiative

As to suggestions, every elder statesman is supposed to give suggestions. In the first place, it seems to me that it is about time this country initiated some programs. The quickest way that you can sell a project in the Pentagon or with the Bureau of the Budget is to show that the Russians have already done it or that you have some special intelligence showing that they might be doing it and therefore we ought to do it. You in industry are more aware than I that when you start copying your competitor's product you had better dispose of your stock options because they are not going to be worth very much.

And we have been lagging, not leading. This is a great country and it has tremendous resources. It is time to get over the inferiority complex and go out and decide what we want to do first and do it. We have not been doing that for a long time, certainly not in the last three or four years. I would predict, for example, that if tomorrow morning CIA or somebody through devious means determined that the Russians had dug a 50 mile hole, 25 feet in diameter in Siberia, the next morning you would have 50 scientists in Washington with more projects for digging holes than you've ever seen.

Let us decide what we want to do and what we think makes sense for the Free World. Let us then plan it on a long-term basis and stick with it. I personally am not impressed with going to the Moon. I have been unimpressed with it ever since I was in the Army and have said so on many occasions, strictly as far as the Army is concerned. Our job is to use space for our mission on the surface of the earth. And we have more missions on the surface of the earth today than we can handle.

Let us have some real United States programs; let us have the kind of programs that make sense to Southeast Asia or India or the Congo. I do not think going to the Moon makes any sense to you when you are hungry and you have about 5 ounces of rice a day.

(Continued on page 36)

 POLARIZED SOLID-ELECTROLYTE TANTALEX® CAPACITORS Type 150D Engineering Bulletin 3520D	 NON-POLARIZED SOLID-ELECTROLYTE TANTALEX® CAPACITORS Type 151D Engineering Bulletin 3521	 FEED-THRU SOLID-ELECTROLYTE TANTALEX® CAPACITORS Type 180D Engineering Bulletin 3525	 SOLID-ELECTROLYTE TANTALEX® CAPACITORS for Hearing Aids Type 160D Engineering Bulletin 3515A
 85C FOIL-TYPE TANTALEX® CAPACITORS Type 110D, 111D (plain foil) Type 112D, 113D (etched foil) Engineering Bulletin 3601A	 125C FOIL-TYPE TANTALEX® CAPACITORS Type 120D, 121D (plain foil) Type 122D, 123D (etched foil) Engineering Bulletin 3602A	 'CUP-STYLE' 85C SINTERED-ANODE TANTALEX® CAPACITORS Type 131D (industrial) Type 132D (vibration-proof) Engineering Bulletin 3710A	
 'CUP-STYLE' 125C SINTERED-ANODE TANTALEX® CAPACITORS Type 133D Engineering Bulletin 3711	 85C SINTERED-ANODE TANTALEX® CAPACITORS Type 109D Engineering Bulletin 3700D	 125C SINTERED-ANODE TANTALEX® CAPACITORS Type 130D Engineering Bulletin 3701	 'MICROFARAD-PACKAGE' TANTAPAK® CAPACITORS Type 200D Engineering Bulletin 3705 <small>*trademark</small>

SPRAGUE TANTALEX® CAPACITORS

**Industry's widest tantalum capacitor line
eliminates size-and-quality compromises!**

● No makeshifts! No compromises! When the circuit calls for a tantalum capacitor, you'll find what you want in Sprague's famous Tantalex Line. Pioneer in the development of tantalum capacitors, Sprague makes a Tantalex capacitor to meet practically every designer's requirements. Unmatched experience and the largest and most

complete production facilities in the capacitor industry make Sprague your dependable source of supply!

● Write for engineering bulletins on the Tantalex Types which interest you (see bulletin numbers above) to Sprague Electric Company, Technical Literature Section, 287 Marshall Street, North Adams, Massachusetts.

● Most-frequently-used Tantalex Types are available for off-the-shelf delivery at factory prices on pilot quantities to 499 pieces from your local Sprague Industrial Distributor.

SPRAGUE COMPONENTS

CAPACITORS
RESISTORS
MAGNETIC COMPONENTS
TRANSISTORS

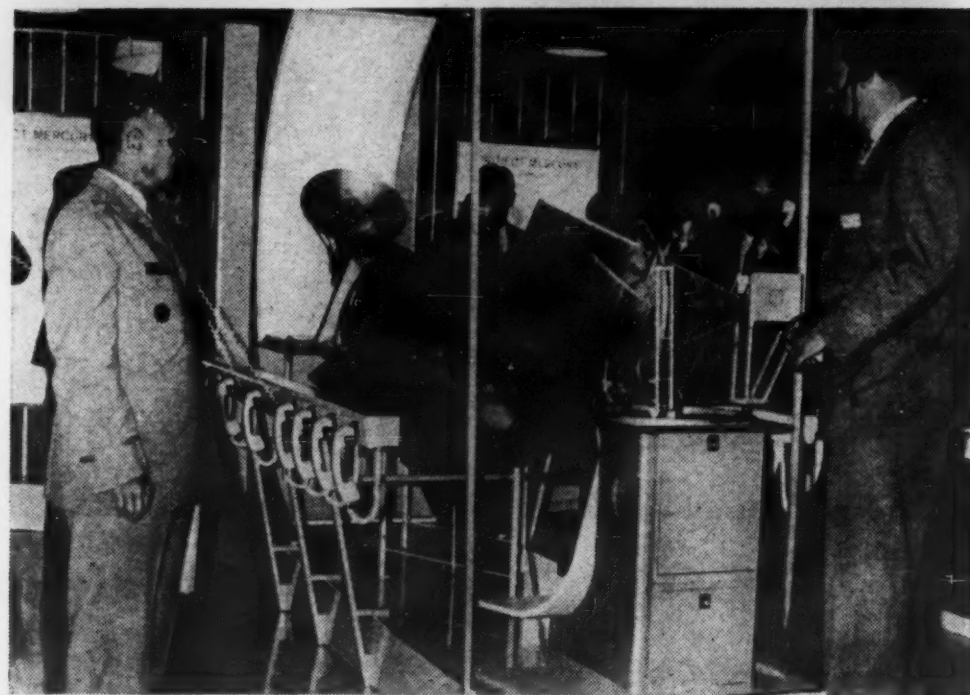
INTERFERENCE FILTERS
PULSE TRANSFORMERS
PIEZOELECTRIC CERAMICS
PULSE-FORMING NETWORKS

HIGH TEMPERATURE MAGNET WIRE
CERAMIC-BASE PRINTED NETWORKS
PACKAGED COMPONENT ASSEMBLIES
FUNCTIONAL DIGITAL CIRCUITS

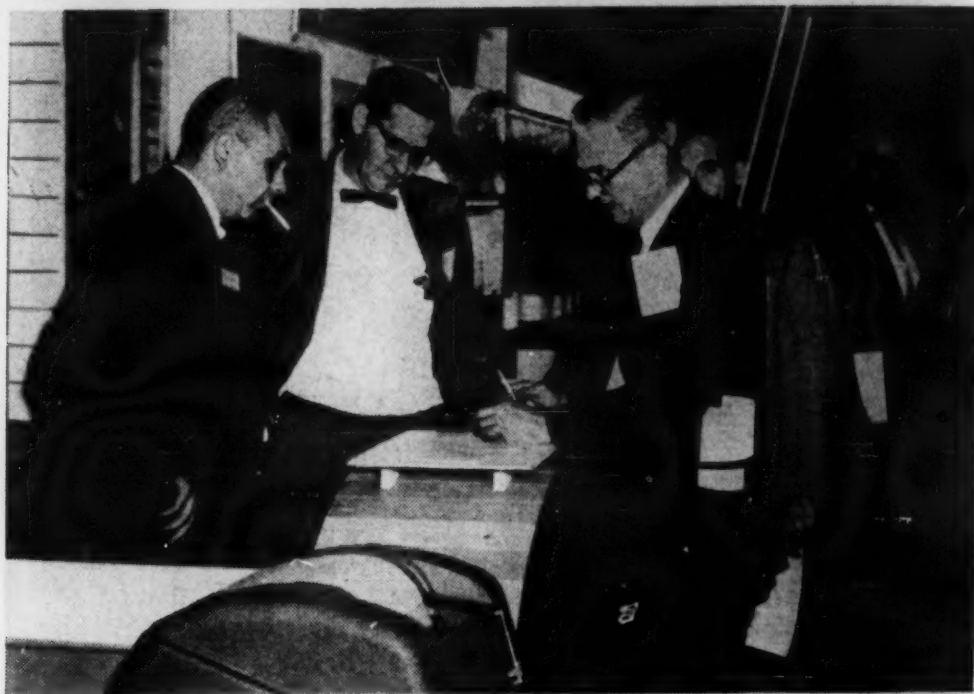
SPRAGUE

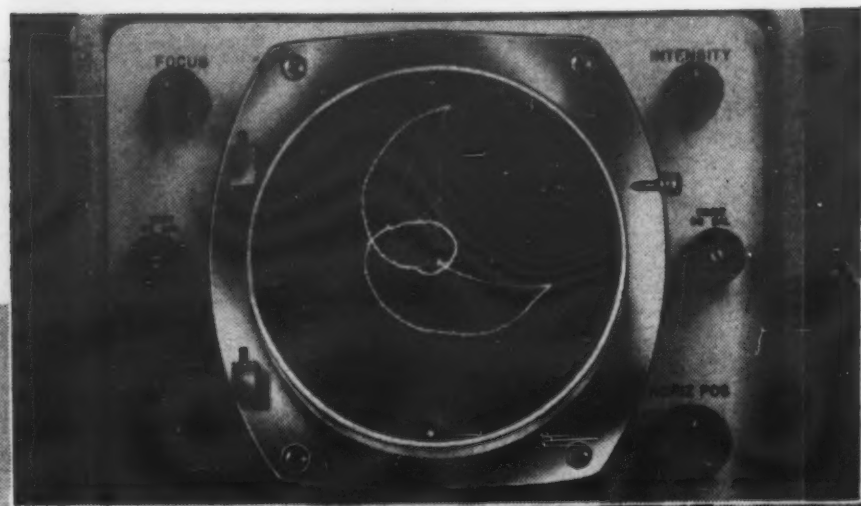
THE MARK OF RELIABILITY

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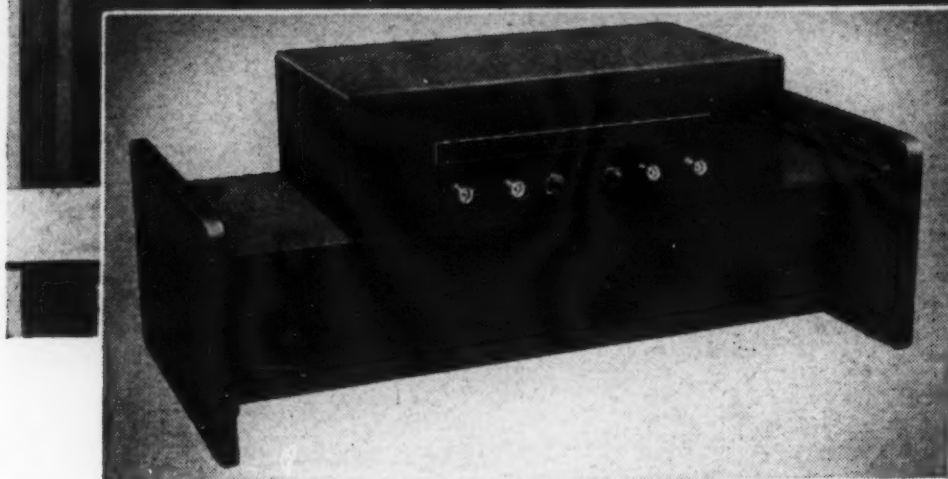
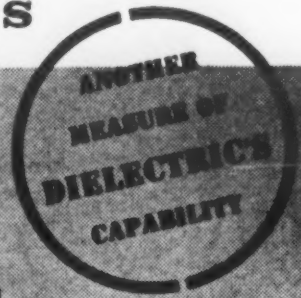


Exhibits





NOW IN WAVEGUIDE...
the best way yet to measure
complex impedances



Here is the first major breakthrough in the measurement of complex impedance over a band of frequencies. For speed, simplicity, and reliability, it surpasses anything yet used. It's the Smith Chart Plotter, developed by Dielectric Products Engineering Company to obtain instantaneous Smith-Chart display of reflection coefficient as a function of frequency.

Recently 50-ohm coaxial models were announced. Now these instruments are available in waveguide as well. Five resolver models span the range 350 to 12000 mc/s. Calibrated mismatch loads are also available.

This unique instrument — along with appropriate auxiliary equipment to form the complete plotter — eliminates the need to tie up highly skilled technical personnel during prolonged test routines that characterize slotted line measurements.

HOW IT WORKS

With Dielectric's Smith Chart Resolver, a swept-signal generator sweeps repetitively over the frequency band desired. The reflection coefficient of the unknown load is resolved into its X and Y components, which are then applied to the X and Y amplifiers of an oscilloscope equipped with a Smith Chart faceplate. A continuous trace of reflection coefficient versus frequency is thus displayed directly. The faceplate can be either a full-scale chart, or one expanded to 1.5:1 VSWR.

As load changes or adjustments are made, impedances change. Simultaneously so does the trace... load changes are observed immediately. When a permanent record is required, the oscilloscope trace may be directly photographed. Or, if preferred, an X-Y chart recorder may be used.

If you're looking for a way to speed up impedance measurements on antennas, filters, load resistors, transformers and other r-f networks, the Smith Chart Plotter is the essential tool. It's more accurate, too.

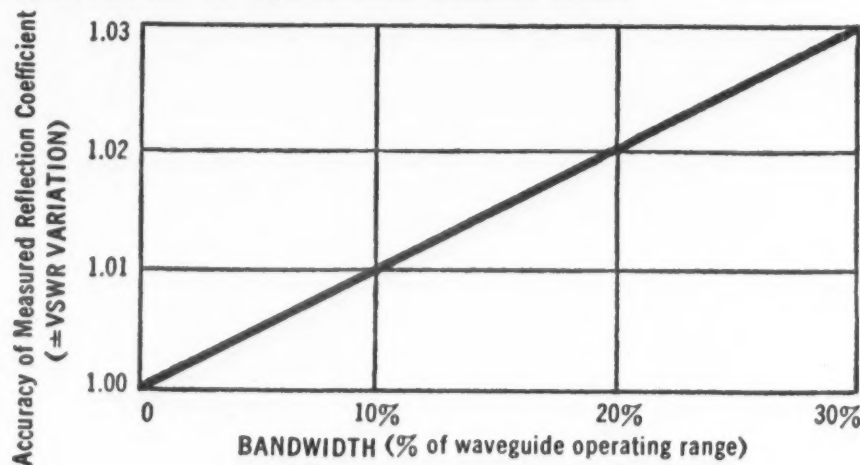
And there is more to come. For the measurement of r-f impedance in systems at any power level to the highest that can be generated, in either waveguide or coaxial line, other forms of the plotter will soon be available to supply a Smith Chart display. These will be particularly useful as system monitors.

SPECIFICATIONS

Nominal impedance.....	Z_0 (Waveguide)
RF input voltage.....	0.35 volts, rms
Oscilloscope signal voltage ...	0.2 volts input required for full scale deflection on expanded Smith Chart (1.5 VSWR max) for DC oscilloscope having 1 centimeter/millivolt sensitivity
Accuracy of reflection coefficient measurement	see graph below
Sweep rate (maximum).....	60 sps
Spot rotation rate (maximum for full accuracy)...	1000 rev/sec
RF input-output terminals	Optional
Automatic level control terminals.....	BNC (where required)*

*ALC information supplied with unit.

For complete description, ask for Bulletin 60-3. You'll get the latest revision and supplement which include both waveguide and coaxial units.



Other areas of DIELECTRIC capability in coaxial, waveguide and open wire techniques...

TRANSMISSION LINE & COMPONENTS • NETWORKS • SWITCHES • TEST EQUIPMENT • R&D ENGINEERING

die DIELECTRIC
for solutions to
communications
problems.



DIELECTRIC PRODUCTS ENGINEERING CO., INC.

RAYMOND, MAINE

At WESCON, see the Smith Chart Plotter in action. Booths 4014-4016



BANQUET ADDRESS

by

FREDERICK R. KAPPEL
President
American Telephone and Telegraph Company

EVER SINCE THIS Association was organized, we in the communications industry have welcomed the opportunity to take part in its affairs. We believe in it and want to contribute to its usefulness. Certainly this is how we in the Bell System feel, and I have no doubt that the other communications companies of the country, as well as our fellow-members in the fields of electronics and photography, take the same view.

I shall stick pretty much to a single point this evening, and the point I have in mind begins with this question: Why are we all here anyway? Why are we members of this Association? As I see it we have one purpose only. This is to make ourselves better able to contribute to the military strength and security of the United States. We civilians are members because we want to know military men and their problems, and in order that they may know our capabilities. We want to understand each other and also to stimulate each other. We want to bring out differences of opinion and judgment and get them resolved. But we don't want them resolved in your favor or my favor or anybody else's favor. We want them resolved in the country's favor, period.

Furthermore, the urgency of our purpose is mounting every day. Or so it seems to me. Can we doubt that the threat to our national security is critical? Can we suppose that anything less than the best effort we are capable of will be sufficient to meet it? I do not think so. And so, to speak for the Bell System, I would like to indicate the nature and extent of our commitment as we see it today, and give a few examples of the effort we are making. I might say too that while speaking on behalf of the organization I represent is as far as I can properly

go, I am well aware that others in many fields have just as strong a sense of their defense obligations.

What we feel we must do can be stated with no if's, and's, or but's. We must give the military what they need. I don't see any limiting qualifications here. I don't see how there could be any. This is the test and we cannot meet it with B or C grades. We have to get straight A's.

Private Enterprise

Now I doubt that there is anyone who feels more strongly about the virtues and values of private enterprise than I do. But however we may advocate these values in words, it is deeds alone that make them real. In communications, I think the facts show without question that private enterprise in the United States has produced the most extensive, dependable, and useful service in the world. This has been a great national asset in two world wars and it is a very great asset today. But again I emphasize—it is the facts of accomplishment that count, and I am simply trying to say here that it will take much, much more of the same kind of doing to prove our point for the future.

The essence of private enterprise to my mind is clearly stated in the phrase itself—I mean enterprise, initiative, creativeness—everything a business will do to search for good answers on its own responsibility. It is this above all that the country needs from us in industry to help us build our national strength.

It was in this spirit, for example, that we set out seven or eight years ago to build very extensive long distance communication routes avoiding designated critical target areas.

It is in the same spirit that we began construction last

year of a new "hardened" cross-continent coaxial cable, entirely buried from end to end. This we are going ahead with at costs considerably higher than the costs of normal construction.

It is very much in the same spirit that we have pressed the development of new-type ocean cables and speeded up schedules for getting them into service. With *both* cable and satellite circuits in abundance, we shall get not only greater capacity but more firm assurance of reliability.

Survivability of Communications

Please understand me. I am giving a few examples to illustrate a point of view. We don't think these projects answer all the problems. Of course they do not. Probably most people will agree that they are useful and important steps along the way. But like our friends in the Armed Forces, we in the Bell System are sharply aware that conditions are changing with great speed. We understand very well that the survivability of critical communications is all-important, and that attack on the communication system itself must not be permitted to succeed in its purpose. In short, we know how hot this griddle is. It is uppermost in our minds—and this is my point—that in our search for answers, the initiative and enterprise of communications people are more necessary than ever before.

To put the same thought differently, our job is to improve and strengthen by every practical means the facilities we already have, and at the same time develop new ones.

Thus, to the diversity of the Direct Distance Dialing network we must add still more diversity. We must have more alternate routing of circuits by more effective means. We must work out means for more automatic restoral so that military networks will be self-healing to the highest degree possible.

The blowing up of three repeater stations on a trans-continent route ten days or so ago (May 28) simply underscores what I am saying. In this instance critical communications were maintained over alternate paths, since dual facilities had been provided, and circuits that were lost were soon restored over still other routes. Pre-arranged plans for meeting just such an emergency worked well, but the lesson is clear: We cannot be too thoroughly prepared, and what we are doing today we must learn to do better tomorrow.

Harden Communications Facilities

We must harden communication facilities where that is called for, and as I have indicated we are moving on this. The new cross-country cable system I mentioned will have all repeater and switching stations installed in heavily reinforced concrete underground vaults, and certain key stations will be manned around the clock. Before going ahead with this system, we tested the construction under blast conditions and found, for example, that the cable successfully withstood a pressure of well over 200 pounds per square inch. The system can operate self-sufficiently on its own generated power and will have an ample water and reserve fuel supply.

As another example along this same line, a new long distance building now under construction in New York will be windowless and fallout-protected.

We are also deeply interested in mobility as a means of protection. This has many aspects. To speculate on one, can an airborne microwave system link key areas by means of radio relay stations on circling aircraft? We have studied the possibilities and problems intensively and believe the findings are well worth full consideration.

As to satellite communications, we have tried to make clear, and by now we have stated many times, that both technically and financially we are ready to move on the double as soon as launching and other arrangements can be made with the Government. Apropos of this, I have heard that at least one skeptical military man has asked, "Is the Bell System really serious about spending the kind of money required?" The answer I can assure you is yes, we are. We have the money, our research and development work in the satellite communications field has made us ready to move with confidence and dispatch, and we have a lively appreciation of what it will take to assure dependable and ever-ready world-wide service.

In all our work with satellites, we are intent on learning everything we can that will be useful for military communications, and we shall certainly expect to cooperate with the Armed Forces in all appropriate ways. Recently we testified before the House Committee on Science and Astronautics on the urgency of creating a satellite system to help meet military as well as other government and public demands. I won't go over the ground again, but I would like to remind this audience of one point of special interest—namely, that the system we have proposed is extremely flexible and would permit use of portable ground stations to give access on short notice to remote trouble spots around the world.

Responsibilities for Defense Communications

A month or so ago we had a meeting of the presidents of all the Bell System companies. One of the subjects was what I have been talking about here—our responsibilities for defense communications. Just for emphasis, I would like to tell you some of the main questions we pressed on each other. Here they are:

To begin with—are we making speed our watchword? And this means speed in all its aspects: Speed in ascertaining the military's needs. Speed, the utmost speed, in establishing the vital connection. Speed in developing new devices and systems. Speed in producing them and getting them in being.

Are we further extending and increasing facilities that by-pass military targets?

Are we providing sufficient hardening and fallout protection at appropriate locations? Are we developing improved designs for hardened plants?

What is the best balance of hardening, redundancy or diversity in the network, and mobility?

Are we generating realistic studies of survivable communications for military command and control—learning to pin-point where the greatest needs lie—and striving to develop new modes of communicating?

Are we giving full and proper consideration to more extensive alternate routes, and ways to get them into action sooner in emergencies?

Are we doing all we ought to do in designing dedicated military networks that provide priority and automatic restoral—permit the encrypting of voice and data when desired—and afford the utmost measure of reliability and flexibility required for critical command?

And underlying and paralleling these and other efforts, are we at all times working closely with our military customers to know their needs and problems better?

I have repeated these questions here as partial evidence of the degree to which military concerns are our deep concern in the Bell System. The rest of the evidence of course is in how well such questions are answered. But we have no thought except to answer them well. That goes for the cost of service as well as its quality and re-

AFCEA extends its sincere thanks and appreciation to all those who contributed their time and services on behalf of the Association to make the 15th Annual Convention an outstanding success.

To accommodate a full report on the excellent panel discussions and the outstanding speakers, SIGNAL is scheduling its Convention proceedings in both the August and September issues. Therefore the 15th Anniversary Issue, originally scheduled for September, will appear in November.

Transcripts of two of the four panel discussions are published in this issue as are the speeches of Frederick R. Kappel and Richard S. Morse. The Industrial Luncheon speech given by Major General Kenneth P. Bergquist will appear in the September issue as will the remaining two panel discussions plus Convention photographs.



A MESSAGE FROM

W. J. Baird

General Manager, AFCEA
Editor, SIGNAL



liability. Serving the Armed Forces as efficiently as possible is a clear obligation and we intend to meet it.

A Welcome Challenge

I would like to say to our military friends that we welcome the pressures you put us under. This does not mean that in a different kind of world we would prefer the problems of defense to the arts of peace. The needs of defense are a gigantic burden on the whole country and we all know it. Nevertheless the burden is inescapable and as long as that is so we want to tote our share as well as we can. In research and development work, the jobs you assign us sharpen our cutting edge. The same is true of skills in manufacture and operating competence. Everything you require of us helps our abilities in all our work. We want assignments from you, we intend to compete for them, and we welcome your demanding exactitude. But I don't expect you ever to be satisfied. If you are, that would really worry me.

My last thought is this:

The fundamental concern of all of us regarding military communications is survivability. If this country should be attacked, then without question critical communications must survive if the nation is to survive. It is clear therefore that every feasible technical step to insure survivability must be employed, and we are determined that none will be overlooked. But at the same time, in addition to technical and physical improvements, let us also remember human experience and human competence, well organized and often tested under conditions of emergency.

I am not so misguided as to attempt to compare the situation under a hydrogen bomb attack with past emergencies caused by earthquakes, hurricanes, floods,

and other disasters. Nevertheless, the fact remains that many thousands of telephone people all over this country are trained and conditioned to deal with the unexpected, whatever it may be. They have a vast amount of knowledge and down-to-earth operating skill. They have an attitude, a natural disposition and instinct, to fix whatever may go wrong. They also have some other extremely important assets. For one thing, they have immediate authority to act—every test center, for instance, can act immediately. Second, they have detailed, specific programs as to what to do under differing circumstances. Third, a nationwide pool of materials, equipment, and other skilled people is available to help.

Without in the slightest degree minimizing the problems, I just hope that no one will underestimate what I will call the human resilience of the communications industry. For three generations or more, men and women in all the communications companies have cooperated effectively in protecting vital service against hazards of many kinds. This has left its mark on us as individuals and as an industry. It is a good mark and we are going to keep it so. In my judgment no single thing is more important to the survival of communications and the continuity of command.

As I said at the start, I have talked mainly about Bell System effort because that seems a natural boundary for me to observe. But we in our business well know the competence, the progressiveness, the dedication of our fellow-members in this Association. I am confident that all of us in communications, electronics, and photography, associates and competitors alike, are united in devotion to the great task of building the nation's defenses as strong as they ever need be. We are proud to serve our country and determined that our enterprise shall back the Armed Forces to the limit.

MILITARY EXHIBITS

Among the military exhibits at the Convention was a display depicting Project Advent. Advent, a coordinated tri-service program under the direction of the U.S. Army Advent Management Agency, is aimed at demonstrating the feasibility of an instantaneous military global communications satellite system.

Another exhibit included a SPASUR display and a typical Navy tributary station communicating with remote stations. The Navy Space Surveillance System detects, tracks, identifies and determines the orbits of all non-radiating space objects within range.

The Air Force's Combat Logistics Network (COMLOGNET) also was displayed. This system, which will become part of the Aerospace Communications Complex in 1962, will automatically transmit both data and narrative information from origin to destination without reducing the information to perforated tape, typed page or any other physical form. This was the first time the terminal equipment for this system had been demonstrated.

A Marine Corps exhibit consisted of a diorama depicting an amphibious attack by vertical assault.



RADIO WINNERS

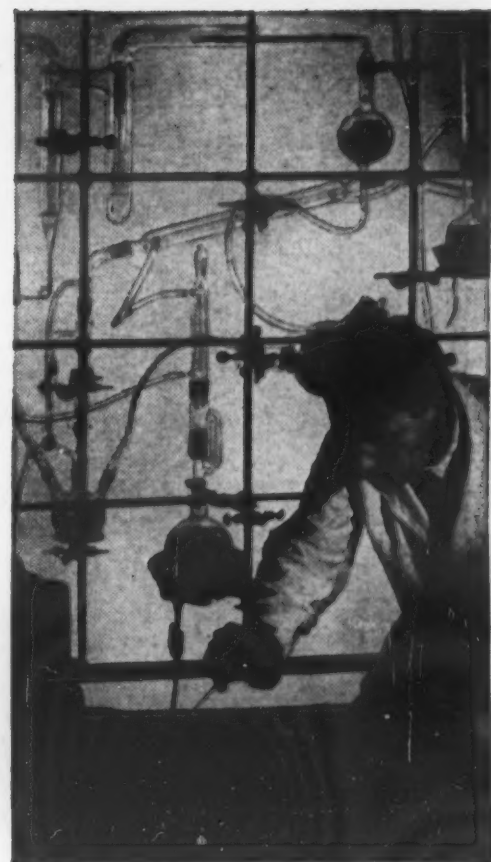
Top Photo, left—Shown drawing names of the winners of the clock radios contributed by Sylvania are (left to right) Col. W. J. Baird, General Manager of AFCEA and Editor, SIGNAL; Mrs. A. W. Christopher; Miss Ruby Brothers, vice president, Dayton-Wright Chapter; and, A. W. "Bill" Christopher, Sylvania Electric Products, Inc. and member of the Panels Committee, AFCEA Convention. In Top Photo, right—C. W. Rusteberg is presented a clock radio by Rear Admiral Frank Virden, Director of Naval Communications. Mr. Rusteberg is an employee of the Navy Department. Looking on are B. H. Oliver, retiring President of AFCEA and Col. W. J. Baird.

Bottom Photo, left—Captain E. S. Cummings, USA, receives a clock radio from William Christopher. Bottom Photo, right—student Barry Newberger, K4C10, receives his prize from Mr. Christopher.



FAIRCHILD BASIC RESEARCH LABORATORY ADDS A NEW DIMENSION TO PHOTOGRAPHIC CHEMISTRY

New insight regarding the interaction of light with solid state photosensitive surfaces is now being gained at Fairchild's Basic Research Laboratory. Defense Products Division scientists are also discovering new facts about the role of free radicals and molecular complexes in the photographic development process. Such knowledge can produce photographic materials of unprecedented speed and resolution which are capable of virtually instantaneous processing. Another result can be very thin solar cells of wide area and sensitive to radiation from the ultraviolet to the infrared which can be of great value in space exploration. Vastly improved developers can also be foreseen in new data concerning photographic chemistry. This basic and applied research and development is contributing advanced products and techniques for military and industrial application, assuring Fairchild's continued leadership in the photographic field. The Basic Research Laboratory and its achievements are available for your programs. For a brochure and further information, write the Director of Marketing, Defense Products Division.



Engineers and scientists are invited to discuss new opportunities presented by continuing growth of the Defense Products Division.



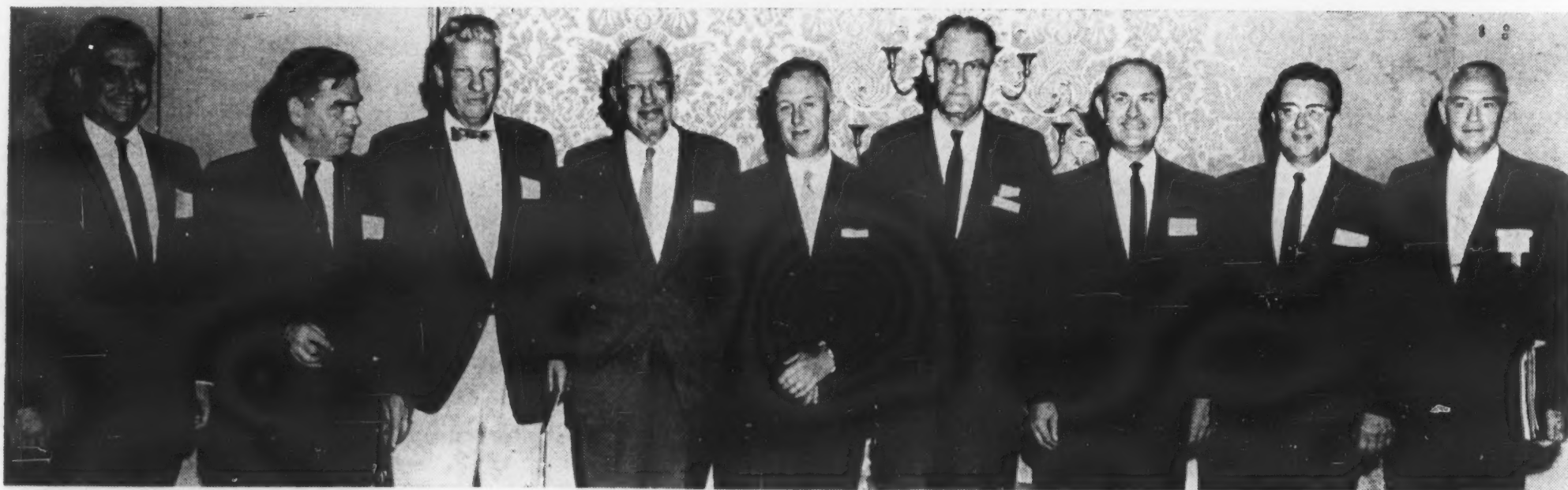
Col. W. J. Baird speaks at the Regional Vice Presidents' meeting. Seated from L to R are: Walter H. Pagenkopf, Kenneth F. Zitzman, B. H. Oliver; and, Col. Frank T. Ostenberg.



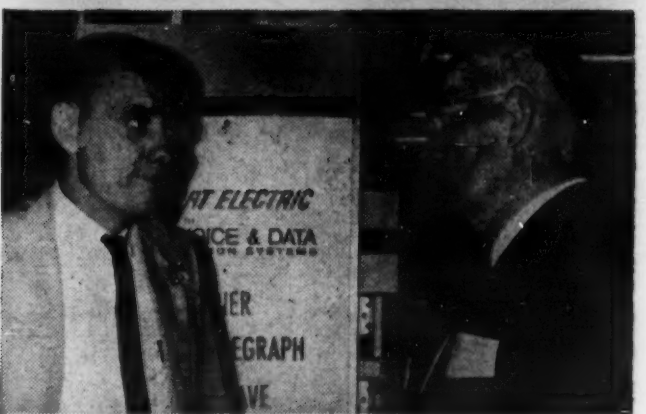
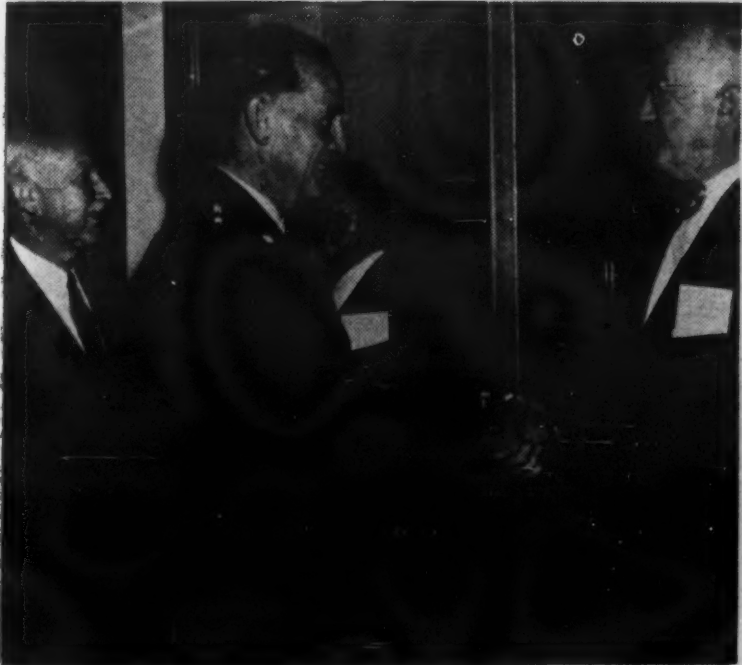
Shown above are AFCEA Chapter Presidents and Delegates attending a meeting at the Convention.

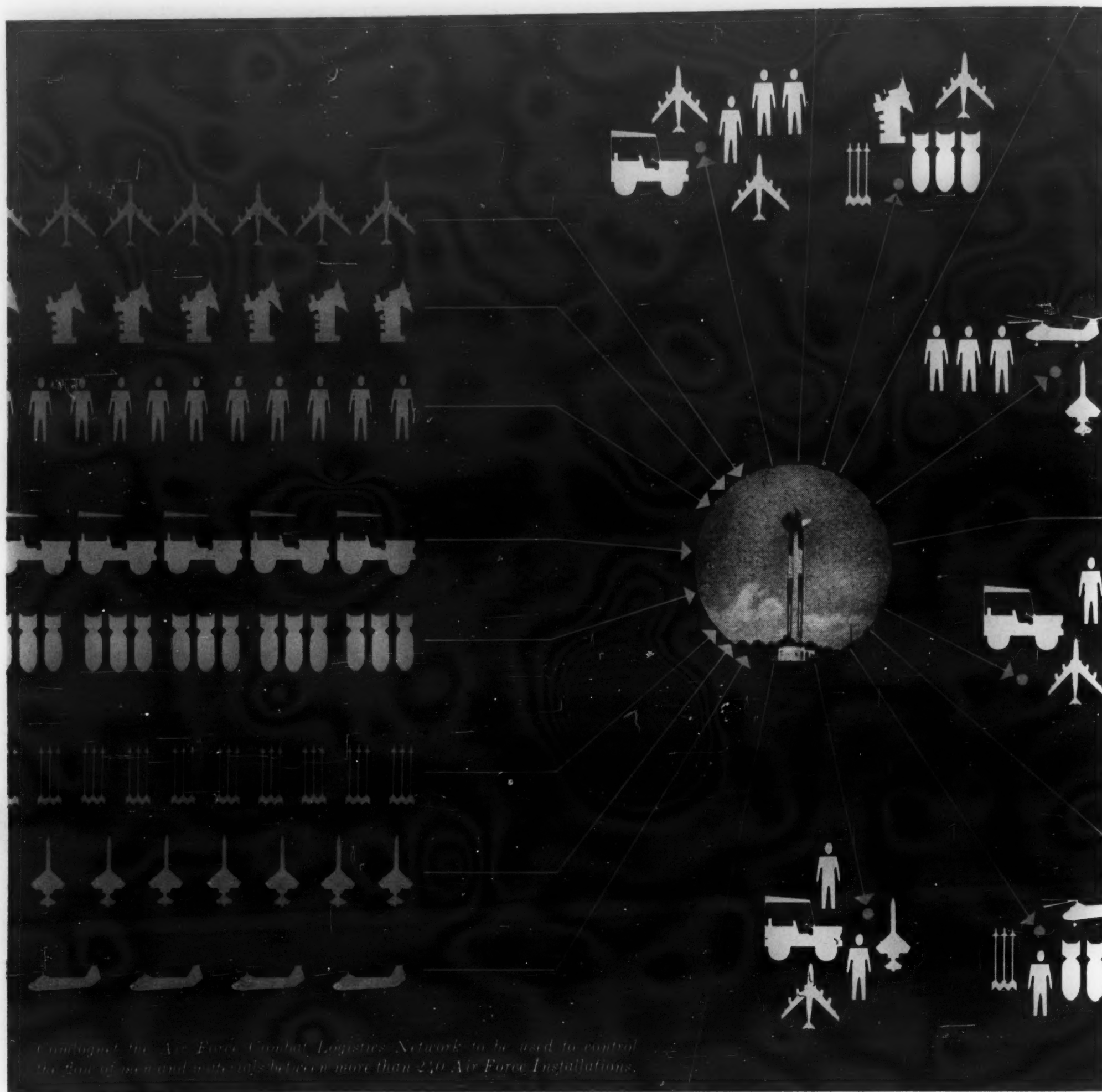


Listening to Association reports are members of the AFCEA Council and Board of Directors.



AFCEA's Regional Vice Presidents are shown (L to R): Brig. Gen. Kenneth F. Zitzman, USA (Ret.); Lt. Cdr. Ray E. Meyers, USN (Ret.); Paul H. Clark; Maj. Gen. Harry Reichelderfer, USA (Ret.); B. H. Oliver, former President of AFCEA; W. K. Mosley; George C. Ruehl, Jr.; Walter H. Pagenkopf; and, Col. W. J. Baird. Regional Vice President Robert B. Richmond was present but not shown in photo.





Comlognet, the Air Force Combat Logistics Network, to be used to control the flow of men and materials between more than 240 Air Force Installations.

COMLOGNET: world's most advanced data communications system designed for the Air Force by Western Union.

This instantaneous communications and data network has the capability of handling every known form of electronic communications swiftly, accurately, and automatically. Upon completion in 1962, Comlognet will have a daily capacity of seven million punched cards in its five U.S. centers, making it the world's largest data processing system. Future expansion,

including the handling of data from overseas installations, will be readily accommodated.

Modernization of Comlognet is another first for the U.S. Air Force and Western Union. Acting as prime contractor, Western Union designed and engineered this electronic network in participation with other companies.

WESTERN UNION . . . finds better ways to speed it electronically



—GOVERNMENT—

SECOND U. S. MAN IN SPACE is Air Force Captain Virgil I. Grissom, who in his Liberty Bell 7 suborbital flight on July 21, 1961, soared 2 miles higher in space (118 miles), 3 miles farther (305 miles) and 180 m.p.h. (5,280 m.p.h.) faster than Navy Commander Alan B. Shepard in a similar flight on May 5, 1961. The space flight, which took 16 minutes from the blast-off of the Redstone booster at Cape Canaveral to Grissom's recovery in the Atlantic Ocean, was marred only by the loss at sea of the 2-ton space capsule containing photographic records of the flight. The bulk of the scientific data, however, was transmitted by telemetry during the flight.

FLEET COMPUTER PROGRAMMING CENTER utilizing the Naval Tactical Data System was commissioned in San Diego on July 1, 1961. The center will house a team of Navy personnel, civilian scientists, mathematicians, and programmers, working with advanced digital computers, to produce computer programs for ships of the Fleet. The center is the first of its kind in the Navy, according to the Defense Dept.

NEW AIR FORCE OFFICE FOR DATA AUTOMATION will define objectives and policy for designing business data systems and command and control systems within the Air Force. Colonel George H. Krieger heads the new office, which is under the direction of the Comptroller of the Air Force, Lieutenant General Frank H. Bogart. The creation of this office is said to constitute recognition of the increasing dependence of the Air Force on thorough data systems design and use of automated data systems.

PRESIDENTIAL REQUEST FOR SATELLITE STUDY contains the directive that a commercial communications satellite system be brought into operation at "the earliest practicable time." President Kennedy has asked the Federal Space Council, headed by Vice President Johnson, to make the study. The study will represent the first comprehensive review made at the White House level of the many policy problems, domestic as well as international, posed by the advent of a communication system using satellites as relay stations in space.

THREE IN ONE PACKAGE containing Transit 4-A, Injun, and Greb satellites was launched by an Air Force Thor-Able-Star missile, on June 28, 1961. Once in space, the Transit navigational satellite successfully separated from the other two vehicles, but Injun and Greb remained together. The first nuclear power unit ever sent into space was contained in the Transit vehicle. The atomic unit, possessing a small amount of Plutonium 238, sent power to two of four radio transmitters and to some instruments in Transit 4-A. Injun is a 40-pound drum-shaped parcel designed to measure intense radiation in the Van Allen radiation belts. Greb, a 5-pound-sphere, carried two detectors to measure X-ray radiation from the sun.

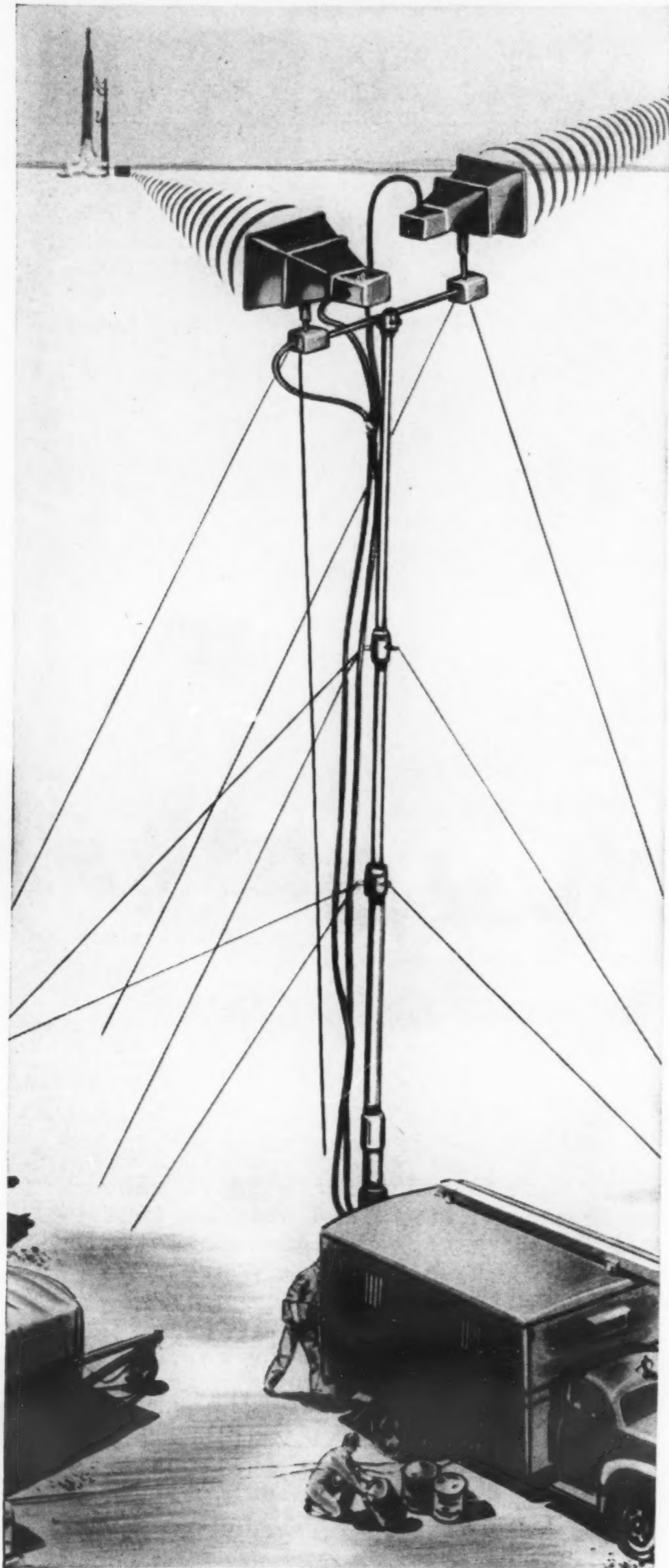
MAN-MADE OCEAN AT DAVID TAYLOR MODEL BASIN will afford the opportunity for the Navy to test the handling qualities of a ship under conditions which resemble actual ocean conditions. The artificial ocean, is part of DTMB's Maneuvering and Seakeeping Facilities, which were dedicated on June 20, 1961. The availability of these facilities marks "a major advance" in the Navy's ability to predict full-scale-performance of waterborne vehicles in realistic seas and to solve complex problems of their stability and control.

MERCURY TRACKING NETWORK TEST is planned for some time late this summer, according to the National Aeronautics and Space Administration. Plans call for orbiting a 100-pound satellite containing transmitting and receiving equipment identical to that used in Mercury spacecraft. The satellite will provide real-time calibration, training and operational experience for the new 16-station Mercury network, as well as an orbital flight test of Mercury communications gear. The satellite, to be called Mercury-Scout I, will be launched into a 300-mile high orbit by a Scout vehicle.

(Continued on page 27)

RCA Mobile Microwave

**for Communications
where needed...
when needed!**



Mobile Station RCA MM-18 Microwave Communication System with portable tower

Standard MM-18 Microwave packages are available from RCA to provide extremely flexible communications systems for mobile applications. Similar to famous RCA equipment that has been proved in use by over a million channel miles, this MM-18 Mobile System provides a broad radio highway over which many teletype channels and duplex voice channels can be operated simultaneously. The directivity of the radio beam and the multiplexing of the communication channels assure a high degree of security for transmitted messages. Truck-mounted, the portable RCA Microwave System also includes a tower that can be rapidly raised and easily transported from one place to another. RCA Mobile Microwave performance matches the reliability found in fixed stations.

MM-18 Systems Ideal for:

- Remote missile bases.
- Command posts to remote launching pads.
- Command post installations for field maneuvers.
- Siting teams requiring high mobility.
- Emergency installations—Civil Defense.

Experienced Microwave engineers will gladly provide additional information. Contact RCA, Dept. Y-291, Bldg. 15-1, Camden 2, N.J. or telephone Woodlawn 3-8000, Extension PC-4560.

Also, New MM-600 Microwave Systems. Long haul, high-density systems for fixed installations. Designed to comply with CCIR/CCITT performance standards. Channel capacity of 600 frequency-division multiplexed voice circuits plus service and alarm channel. Alternately, one r-f channel will accommodate 525-line monochrome television; NTSC color TV or 685 CCIR television.



The Most Trusted Name in Electronics
RADIO CORPORATION OF AMERICA

TIROS III, the third U.S. weather satellite, was launched on July 12, 1961. The 285-pound weather satellite is circling the earth every 98 minutes in a 400 mile high orbit and, like its sister satellites, Tiros I and Tiros II, is transmitting thousands of television pictures of the earth's cloud cover to ground stations for weather analysis. The projected lifetime of the satellite coincides with the current hurricane season and meteorologists are hopeful that the satellite will provide data on the origin, development and movement of the storms. Unlike its predecessors which used one wide angle and one narrow angle high resolution vidicon television camera, the new Tiros will be equipped with two wide angle cameras. This change was based on the earlier experiments which showed that more valuable data for weather analysis was available from the wide angle pictures.

NEW CHIEF OF NAVAL OPERATIONS is Vice Admiral George W. Anderson, former commander of the Sixth Fleet. He succeeds Admiral Arleigh A. Burke, who is retiring after three two-year terms.

FCC COMMEMORATED 50TH ANNIVERSARY of radio monitoring and field enforcement by the United States Government on June 30, 1961. On July 1, 1911, William D. Terrell began enforcing the pioneer Wireless Ship Act that required radio on large American passenger ships as a safety device. Terrell's successors in the Federal Communications Commission's Field Engineering and Monitoring Bureau were the first U.S. technicians to track the Soviet Sputnik I on Oct. 4, 1957. The Bureau used radio directional finders to help locate the pirated Portuguese ship, S.S. Santa Maria, in the Atlantic, on Jan. 24, 1961. In acknowledging the golden anniversary of its field staff, FCC Commissioners formally thanked the engineers for "outstanding service in policing the air waves, detecting clandestine radio transmitters, eliminating interference and contributing to the safety and well being of the General Public."

FCC FIELD ENGINEERING AND MONITORING BUREAU has increased in size and in the scope of its work since the radio inspection service began in 1911. At that time there were three men assigned to the radio inspection service, with an annual budget of \$7,000. Today the Bureau has a staff of 400 with a budget of \$3.2 million. From three offices, in New York City, Baltimore and San Francisco, responsible in 1911 for inspecting less than 500 radios on passenger ships, the field group has expanded into 51 district offices and radio monitoring stations responsible for regulating the traffic of more than 2.5 million FCC licensed transmitters. The Bureau is headed by George S. Turner.

CONTRACTS: ARMY: Western Electric Co., switching and terminal facilities for Universal Integrated Communications System, \$19.1 million; Douglas Aircraft Co., production of components for Honest John rocket, \$8.5 million; Collins Radio Co., Texas Div., production of AN/TRC-80 portable scatter communications terminals, \$4 million. NAVY: Sanders Associates, Inc., production of antisubmarine warfare listening devices, \$2.1 million; Goodyear Aircraft Corp., production of depth charge units for ASROC missile system, \$1.5 million; Ampex Instrumentation Products Corp., production of magnetic tape reproducers, for measuring structure-borne noise and vibration, \$1.4 million; Texas Instruments, Inc., production of airborne radar systems to be used for antisubmarine warfare, weather warning and general purpose search, \$1 million. AIR FORCE: Reflectone Electronics, Inc., subsidiary of Universal Match Corp., production of electronic countermeasures simulators to be used at Strategic Air Command bases, \$11.8 million; Radio Corporation of America, Electronic Products Div., development work on communications and data link subsystem for Dyna-Soar test vehicle; Siegler Corp., design, production and installation of electronic and antenna equipment for space and satellite programs, \$1 million.

— INDUSTRY —

UNIVAC COBOL LECTURE TEAM is conducting a cross-country tour to further apprise the company's customers and field sales organization throughout the United States of the Common Business Oriented Language. The two-month tour through twelve cities is being arranged by Univac, a division of Sperry Rand Corp. COBOL is the successful result of efforts by a government sponsored group called CODASYL (Conference on Data Systems Language) to achieve a common language that describes business problems among computer users and manufacturers. COBOL for the first time makes possible the interchange of computer programs between data processing systems of different manufacturers.

(Continued on page 33)

from General Electric
TWO NEW CAMERA TUBES
DEVELOPED TO MEET
YOUR TELECASTING
NEEDS

 **ELECTRONICS**

ZL-7802*

Supersensitive,
Large Dynamic Range,
Longer Life,
Very High Resolution,
Flatter Field,
Reduced
Beam-Bending,
No Orth Spot



ZL-7803†

High
Signal-to-Noise
Ratio,
Improved
Definition,
Flatter Field,
Reduced
Beam-Bending,
No Orth Spot



TV STATION-DESIGNED...

...for flexibility in your color and special telecast work

ZL-7802 represents a significant advance in image orthicon design. It will pay dividends every day in your studio and remote telecasting. A high-gain, thin-film semiconductor target is the key to ZL-7802 sensitivity and ability to handle wide ranges of scene illumination. This supersensitive target improves depth-of-focus, effectively reduces "stickiness," and permits pickup of dramatically lighted scenes with a minimum of set-up time. The thin-film target also provides excellent high-amplitude response, greatly reduces susceptibility to permanent burn-in damage, affords stable operation during life and eliminates raster burns.

The addition of a field mesh in the scanning section provides excellent landing, shading and dynamic match in color cameras using three image orthicons. Because of this field mesh, only simple adjustments are required and you save on set-up time.

ZL-7802 is interchangeable with the 7629, 7513, 7293, 7293A, 5820 and 5820A.

...for quality you require in critical video tape recording

ZL-7803 is specially designed for studio pickup service where you control lighting and demand high-quality performance. An improved target-mesh assembly assures you of a *high signal-to-noise ratio* (peak-to-peak signal vs. [RMS] noise—min.: 38, av.: 50). A special field-mesh in the scanning section enhances picture quality by providing sharp transition from black to white without spurious effect (white edges). This feature, by equalizing the decelerating field which the scanning beam encounters, causes the beam to strike the target in a more evenly perpendicular direction over the entire target area. This improves flatness of field and corner resolution... helps prevent distortion. The ZL-7803 will noticeably shorten your set-up time and reduce the need to compromise between sharpest focus and minimum background blemishes.

Now you don't have to use a costly color tube to achieve the quality you require in video taping. The ZL-7803 is competitively priced with standard camera tubes. Yet, the high signal-to-noise ratio provides premium video taping quality.

ZL-7803 is interchangeable with the 5820, 5820A, 7293, 7293A and 7513.

Try these new General Electric Image Orthicons in your own cameras. Put them on the tough jobs—for the ZL-7802, demanding special application, color, or low light-level work; for the ZL-7803, critical video taping or quality studio pickup service in black and white or color. You'll appreciate the way these tubes perform.

For additional information, call your General Electric industrial tube distributor or write for descriptive literature... ZL-7802 (ETR-2800) and ZL-7803 (ETR-2801)... to General Electric Company, Room 7249C, Owensboro, Kentucky.

Progress Is Our Most Important Product

GENERAL  ELECTRIC



The Annual Buffet



LADIES ACTIVITIES REPORT

Special events scheduled for the ladies included a coffee get-together in the Madison Room of the Sheraton-Park Hotel each morning, and a luncheon and fashion show in the Colonial Room, June 7, 1961. At one of the coffee sessions Mrs. Gladys Montgomery, McGraw-Hill publications, related some of her journalistic experiences and George Twigg III, Raytheon Co., discussed conditions behind the Iron Curtain. Mrs. Dorothea Ostenberg, Ladies Activities Chairman, reports that approximately 35 ladies attended the events.



ACCURACY RIGHT OFF THE SHELF



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Exhibit
Booth 1615

TACAN test equipment from the world's largest maker of airborne TACAN

Hoffman now offers a new and complete line of specialized test equipment necessary to maintain TACAN accuracy in the field—thus insuring the superior performance built into airborne TACAN equipment. Compact and rugged Hoffman simulators are available as standard off-the-shelf items (federal stock numbers assigned), and at lowest cost. Equipment tests all airborne TACAN models now in use.

HLI-119A (AN/ARM-25) Radio Test Set

JANized portable unit radiates simulated ground beacon signal to check accuracy of any model TACAN (while operating in aircraft) for range, bearing and identification signals. Also checks power and sensitivity. Federal Stock No. 6625-724-8868.

HLI-103B TACAN Beacon Simulator

Simulates functions of TACAN or DME surface beacons to enable maintenance men perform complete laboratory and bench tests on all model TACAN sets. Federal Stock No. 5625-668-4227.

HLD-129 Azimuth Error Analyzer

Detects and provides visual and recorded indication of static and dynamic tracking errors in azimuth portion of TACAN sets being checked by HLI-103B.

HLI-116A Peak Power Calibrator

Measures peak output power of TACAN transmitter in kilowatts without use of calibration charts or auxiliary equipment.

HLD-141/144/146 Instrument & Power Panels

Simulates aircraft wiring in testing all AN/ARN-21 and ARN-65(V) TACAN sets and instruments removed from the aircraft. Federal Stock Nos. 6625-724-9938, 6625-448-7172, 6625-448-7177.

Send for complete data file on Hoffman TACAN test equipment and TACAN air navigational systems.

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Military Products Division

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SIGNIFICANT DEVELOPMENTS AT HOFFMAN HAVE CREATED POSITIONS FOR SCIENTISTS AND ENGINEERS OF HIGH CALIBER, PLEASE ADDRESS INQUIRIES TO VICE PRESIDENT, INDUSTRIAL RELATIONS

SIGNALGRAM (Continued from page 27)

RODNEY D. CHIPP & ASSOCIATES, a new firm of consulting engineers, has been established in Bloomfield, N.J. In the fields of electronics, communications systems, radio and television broadcasting systems, industrial TV and engineering management, the firm will act as consultant to government and the military as well as to private industry. The firm is headed by Rodney D. Chipp, formerly Director of Engineering Planning at ITT Federal Laboratories.

GENERAL TELEPHONE & ELECTRONICS CORP. has recommended to the Federal Communications Commission that provision be made for allocation of a frequency band for an experimental world-wide space communications system, utilizing satellites orbiting 22,300 miles above the earth. Allocation of a frequency band would expedite establishment of an experimental 24-hour satellite by 1963, according to GT&E. Specifically, the company recommended that an experimental frequency band of 10 megacycle bandwidth be allocated below 2000 megacycles.

RAYTHEON CO. will conduct a feasibility study of a new concept for ballistic missile defense called ARPAT. The work will be done under a Department of Defense contract for \$7,008,165. ARPAT is one of a series of studies of possible ballistic missile defense concepts initiated and sponsored by the Advanced Research Projects Agency as part of its Project Defender. Supporting Raytheon in the study program will be the following industrial team: Hughes Aircraft Co., Boeing Co., International Business Machines Corp., and Bissett-Berman Co.

MICROWAVE CORPORATION OF AMERICA will manufacture radar-telemetering systems for the United States Weather Bureau. The systems will employ a new concept of microwave radar technique for the interrogation of remote transponders, according to the company. These systems will enable the Weather Bureau to determine, at a control location, exact wind velocity and wind direction simultaneously from numerous points as remote as several miles from the central weather station.

NEW BRITISH FIRM has been formed by Ling-Temco Electronics, Inc. of Dallas, Tex., and Pye Limited of Cambridge, England. Pye-Ling Limited of Stanmore, England, will market Ling and Pye vibration and acoustic test equipment.

— GENERAL —

SATELLITE "SPACE CHAMBER" designed to duplicate conditions 200 miles from the earth will be in full operation by November at the Sunnyvale, Calif., plant of Lockheed Aircraft Corporation's Missile and Space Div. Costing \$1.6 million, the 55-ton High Vacuum Orbital Simulator will test Lockheed's Agena vehicle, which is used in the Discoverer capsule recovery program and the Midas infrared early warning program.

HAM OPERATORS will have a chance to reminisce when they gather for the Otter Cliffs (Maine) Radio Station Reunion, August 19, 1961. Founded by Alessandro Fabbri, the small experimental amateur radio station was turned over to the United States Government during World War I, and was used for sending and receiving messages from Europe. In 1935 the station was moved to its present site at Winter Harbor, Maine. Radiomen attending the reunion will tour Fabbri Hall, the recently dedicated barracks at Winter Harbor; visit Otter Cliffs; and attend a luncheon at Hancock House in Ellsworth, Maine.

SPACE STAMP bearing a likeness of Astronaut Alan B. Shepard, Jr. has been proposed by Sen. Keating (R., N.Y.) and the National Rocket Club. The stamps and a series of bonds would be used to help finance the United States effort to put a man on the moon.

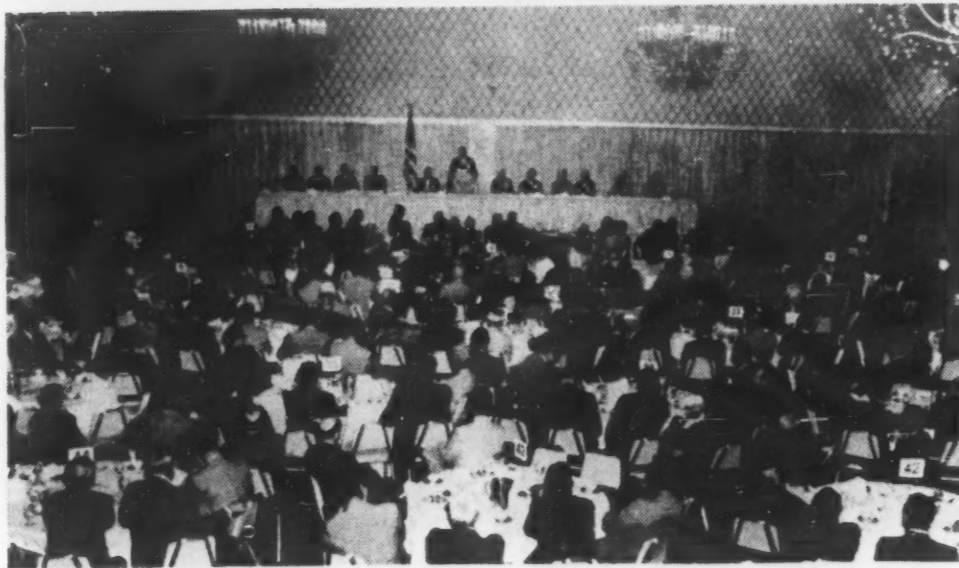
SERIES OF OPINIONS AND INSTRUCTIONS on technical writing and technical publications has been prepared by Thomas R. O'Neill, P.O. Box 441, Passaic, N. J. The first of six booklets contains rules to be followed in writing a technical manual, and information concerning technical copywriting. The series costs \$2.

CALENDAR OF EVENTS:

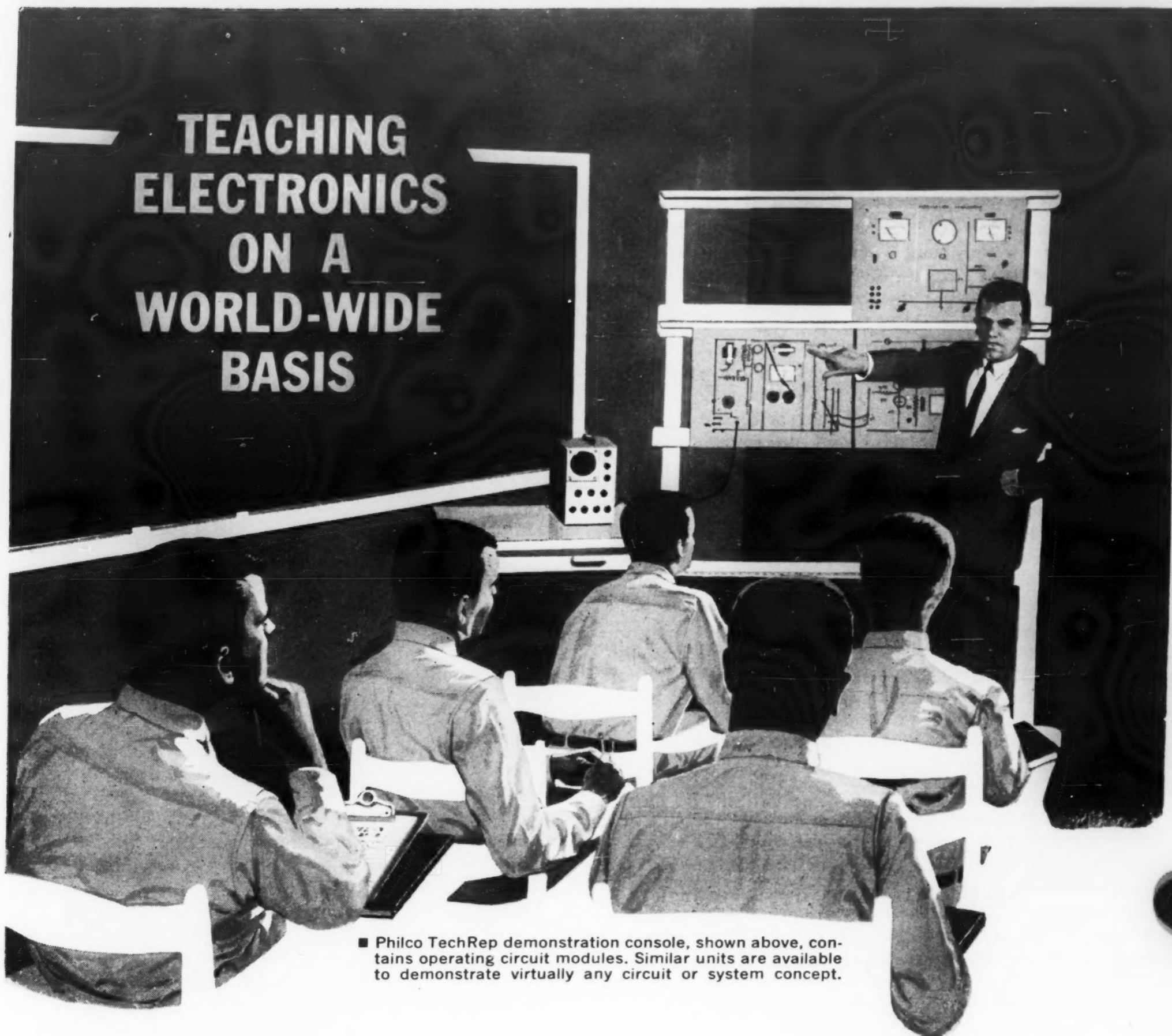
AUG. 22-25: Western Electronic Show and Convention, sponsored by Institute of Radio Engineers and Western Electronic Manufacturers Association, Cow Palace, San Francisco.

AUG. 23-25: Pacific General Meeting, sponsored by American Institute of Electrical Engineers, Hotel Utah, Salt Lake City.

SEPT. 17-20: Transportation and Logistics Forum, sponsored by National Defense Transportation Association, Denver Hilton Hotel, Denver.



TEACHING ELECTRONICS ON A WORLD-WIDE BASIS



■ Philco TechRep demonstration console, shown above, contains operating circuit modules. Similar units are available to demonstrate virtually any circuit or system concept.

Personnel throughout the free world are being trained to teach, operate, and maintain virtually every type of electronic system—through retention-building Philco custom-tailored demonstrations.

In addition to demonstration modules for every circuit and system concept, Philco provides comprehensive supporting literature, a full variety of audio-visual training aids, and instructors—available everywhere—who can serve as your electronic training staff.

Philco, specialist in electronic training for over 25 years, is prepared to serve you with comprehensive electronic training programs tailored to your specific objectives.

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For further information, please write:

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P. O. BOX 10150, PALO ALTO, CALIFORNIA, U.S.A.

IN EUROPE:
TechRep Services S.A.,
Avenue de Beauregard 3,
Fribourg, Switzerland

IN CANADA:
Philco Corporation of Canada, Ltd.,
Don Mills Road, Don Mills,
Toronto, Ontario, Canada

Keynote Luncheon Address

(Continued from page 12)

If I may revert to space again, knowing you people in communications and your interest, I have been very concerned with the communications satellite effort for a long time. Now here is a good case in point. We do not have a national communications satellite program; we never had one. We have had one effort in the Department of Defense; we have one in NASA. Presumably the FCC and other government agencies have some thoughts on the subject, but essentially we are splintered.

If communications satellites make sense—and in my opinion this project is about the most practical use of space there is, certainly in terms of dividends, in terms of our reputation as a free world—here is one we should have been doing a long time ago. We should proceed with it under our free enterprise system to show to the world that American industry can do something. We can get some rewards that we can see, and people around the world will benefit directly. But we are not going to do it until we have one national effort.

This must be done with long-range programming and it should be done honestly by telling the public that we are going to have a great national communications satellite effort which will mean a global communications system. This program will cost \$500 million before it is going to operate on a global basis. We ought to face it by centralizing authority and enlisting the best talent we have in the country to get on with the job.

The Fight For Dollars

While research has been going on in its more complicated vein, in a sense that it is our long-term program, requiring 5 to 8 years for everything we do, we still are talking in terms of a one-year budget cycle. Those of us in the Pentagon who are concerned with the budget, reapportionment, etc., realize that essentially we are fighting for dollars. We must think more and more in the research field on ten-year programs. The Russians get five; we should have ten for a change.

These programs will be keyed to the problems of research administration, keyed to the long-term nature of these complicated systems with which we are concerned, and maybe we can really end up with some achievements first. We will not spend a billion, two hundred million dollars on our nuclear powered aircraft program and then cancel it. Before we start we ought to decide on our final objective, its cost, and its effect on the prestige of America.

Integrated Planning at the Top

I think we have to face this kind of issue immediately, give the real facts to the public, and realize that what we need is integrated planning at the top for R&D on a national basis, not just for DOD, NASA, FPC or Agriculture or Commerce. Somehow we must find a mechanism for putting this together and make Congress realize that these things are not quickies. You cannot suddenly push a button and get results.

Now I want to point out that I am not one who believes in centralization of authority either. We are moving in Defense at a very rapid pace towards centralization of authority and I think it is a great mistake. We must have centralization of planning and we must have centralization of policy, nationally. But we must start delegating the responsibility of execution down the line. You just cannot run a \$43 billion business with five men in the Defense Department, believe me. I believe we have to centralize the planning of long-term thinking, and we

are moving in this direction. Let us be sure, however, that we give the boys down the line responsibility and authority and trust them to get on with the job.

An Incentive System in Government

This means that we have to get good people in Washington. I tried to wonder what one might do in this regard. We do not have an incentive system in government, and I do not know how you do it. In industry we have a profit motive and that is what has made America what it is today. Somehow someone must figure out a different set of standards for excellence in government. Somehow we have to promote people in Washington, not forgetting 5,000 in Civil Service under them (which means you automatically get a new job), but for doing a job well or saving some money or reaching target A quicker than anybody thought it could be done. I think this is very important. If we don't do this I don't know what is going to happen down here, because the reasons for getting rewards in government are not the reasons for getting awards in industry.

Conflict of Interest Problem

I think that we must also concern ourselves with this conflict of interest problem in Washington which is, I'm afraid, getting worse rather than better. To my mind you cannot legislate morality. If a man comes to Washington from industry you can't then pass a law which makes him honest. He is either honest or he isn't, and if he isn't, I am sure he will find a way around the law. We tried this in prohibition many years ago, yet at the moment we are moving, unfortunately, in the direction of making it more difficult rather than easier for getting competence in Washington.

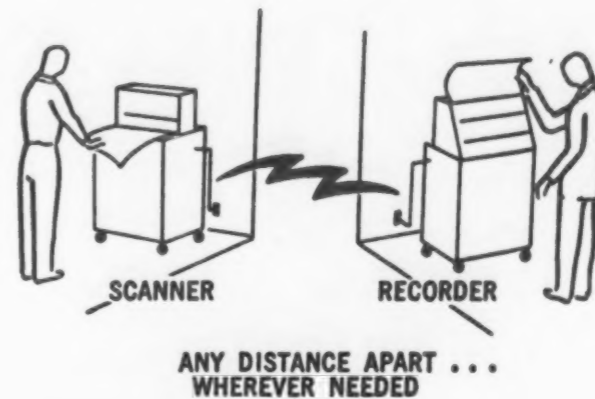
Well now, in closing, I want to say that I have had a great time here in the last two years. I think we have a tremendous number of the most dedicated people I have ever seen in my life and I speak of both military and civilians. There has been a little lack recently of standing up and speaking for the military, and I want to take this opportunity to say that this is the greatest group I have ever seen. They operate under tremendous difficulties. You know we can all sit around, as civilians, and be critical of our general friends and say why don't you do this and why don't you do that. These men are supposed to wait for 15 years doing nothing and then in 15 minutes go out and put on the darndest sales campaign, production campaign or advertising campaign that you people have ever done in your life.

The problem here is not the military and not the top civilians in any branch of government. They are a hard working group and very talented. If you analyze interservice rivalry—to use a canned phrase—it all comes back to the budget cycle, in my opinion. You can go out to the Seventh Army in Europe as I have done, and you don't see any problem between the Army and the Navy and the Air Force. They are all out there as Americans trying to do a job.

You get inside the Pentagon and everytime you turn around you have the Bureau of the Budget and this is a very debilitating kind of influence. It is really not the lack of good people down here, but the environment in which we operate. And I am not smart enough to suggest changing it. All I want to say is, in parting, that I have never worked with a more dedicated group of military and civilian people or a higher level intellectual capability anywhere in my industrial life, and I think any of you who had been here would agree. I wish them the best of luck. Let us make the system work.



High priority, graphic communication data covering the full spectrum of business messages — from full scale drawings to two letters at a time — are examined at a demonstration of Alden High Speed Facsimile.



Alfax Paper and Alden Recording Techniques

From 1930 on, Alden has continuously engaged in facsimile development and application. Most significant was the development of Alfax "A" Recording Papers — the first and only stable and high speed electro-sensitive recording paper, which combined with Alden "adjusterless" Recording Techniques and simplified Flat Copy Scanning — form the basis for the important breakthrough in practical facsimile equipment and systems.

In 1946 ALDEN ELECTRONICS was set up as a manufacturer's manufacturer to supply systems, equipment, component recorders, scanners and their elements to users, OEM, and R&D groups in facsimile and instant graphic recording fields. This company can serve as the key to exploiting the new horizons opened by Alfax "A" Paper and Alden Recording and Scanning techniques and to benefit from the electronic packaging and manufacturing techniques of the original Alden Products Company

TODAY — Alden Electronics' equipment is standard throughout two national U. S. Weather Bureau facsimile networks. Backed up by over 200 service centers throughout the nation. Alfax Paper and Alden Recorders are also superimposing a whole new strata of instant graphic "quick see" recording devices in every scientific field from Oceanography to Radio Astronomy.

It is the fastest growing company in the facsimile field and is being joined by outstanding leaders who find that Alden recording techniques and Alfax "A" papers can expand and develop their markets.

ALFAX PAPER & ENGINEERING CO., INC.
making Alfax paper available to all for use or re-sale without restriction.

ALDEN RESEARCH FOUNDATION
providing an integrated and coordinated program for the use of Alden techniques and know-how.

ALDEN PRODUCTS COMPANY
making available the basic components to mount, house, fasten and connect electronic circuitry so that equipment is simple to roll-in, plug-in, operate and maintain.



can serve you as the key element of the only integrated team for providing every essential element from basic parts to complete systems in the facsimile field.

We invite your inquiries.

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Westboro, Massachusetts U.S.A.

Now!...Practical, High-Speed Facsimile for the High Priority Graphic Information of Government, Industry & Commerce

In facsimile — the key to cost is utilization of transmission lines and equipment. So far, the biggest expense has been line cost. The greatest bar to full utilization of systems has been lack of flexibility in equipment.

Line costs are now plummeting — through the great increase in private "voice" networks, the recent availability of private microwave channels, and the filing of tariffs by A. T. & T. Company of low cost, broad channel communication links in their "Telpak" offering.

Alden facsimile equipment has the proven flexibility . . .

to take documentary copy of any size and shape, to operate on any channel (microwave, "voice" channel, broad channel), to operate at any speed (from 8 min. letter to 2 letters/min. or at any higher speed) with proven, practical designs . . . (standard equipment for the U. S. Weather Bureau on 2 national and territorial networks).

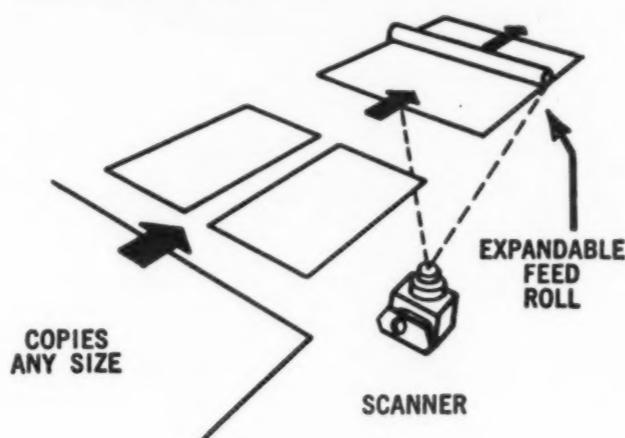
Alden equipment handles the entire spectrum of high priority graphic information.

Not restricted to letter size copy, Alden Flat Copy Scanners readily accept originals of any length, width or thickness. They have the flexibility to transmit everything from full scale layouts and plan drawings to 2 letters at a time or small size messages whether shingled or in parallel. Messages can be fed continuously or selectively scanned for greatest flexibility. The tremendous variety of messages that can be sent results in *highest utilization of equipment* for all high priority graphic information.

Alden equipment can load match the traffic of any system.

Not only the entire spectrum of size, length and thickness of copy can be

COPY CAN BE FED CONTINUOUSLY IN ALDEN FLAT COPY SCANNER 19" WIDE



handled — but the most practical speed for the load can be chosen from standard Alden equipment to get the *highest utilization* of the communication link or channel selected. Alden equipment is not fixed at high or low speed. Through the use of modern tape equipment the ability to store at one speed and transmit at another gives *complete flexibility* to any systems layout — insuring highest utilization.

Alden equipment is designed as self-contained, modular units . . .

with low maintenance and running costs. Scanners can be placed wherever information is developed — fed into the facsimile communication system or network — and recorder placed wherever information needs to be utilized.

The ability to get highest utilization —

from Alden equipment does not come about by accident, but is made possible by the techniques Alden has pioneered.

PANEL DISCUSSIONS

AFCEA members and guests were briefed on the latest developments in communications, electronics and photography at the four panel discussions during the 15th Annual Convention. Satellites vs. cables, management of international communications systems and switching requirements for these systems were some of the subjects discussed at the "Present Media and Future Concepts of World-Wide Communications" panel presented by International Telephone & Telegraph Corporation. Electroluminescent displays for missile tracking, and the use of underground waveguides for low frequency communications systems were some of the topics examined at the "New Frontiers in Reliable Communications" panel presented by General Telephone & Electronics Corporation. These two panels are published in this issue. "Scientific Applications of Electronics in Photography" panel presented by industry and military participants, and "Recent Developments in Government Contracts and Procurement Procedures Stressing Electronics" panel presented by the Federal Bar Association will appear next month.



ITT Panel: (left to right) John Granlund, Frank Fairley, L. A. de Rosa, Frederick Furth, Dr. Henri Busignies, Walter Glomb, Louis Pollack, Robert Plouffe, Kenneth Zitzman.



GT&E Panel: (left to right) Alan Culbertson, Dr. Seymour Stein, Dr. Herbert Trotter, Dr. Allen Solomon, Dr. Robert San Soucie.

PANEL ON

PRESENT MEDIA AND FUTURE CONCEPTS OF WORLD-WIDE COMMUNICATIONS

BY INTERNATIONAL TELEPHONE & TELEGRAPH CORP.

MODERATOR—DR. HENRI BUSIGNIES, VICE PRESIDENT, GENERAL TECHNICAL DIRECTOR, INTERNATIONAL TELEPHONE & TELEGRAPH CORP.—

INTRODUCED BY RADM. F. R. FURTH,
VICE PRESIDENT, ITT CORP.

SYSTEM ASPECTS OF WORLD-WIDE COMMUNICATIONS

L. A. DE ROSA, VICE PRESIDENT, ITT COMMUNICATIONS SYSTEMS, INC.

THE DEMAND FOR communications has been estimated as doubling within the next five years. This increase is predicted as holding not only for civilian communication requirements but also for military communication needs. The communication engineer must, in order to make it feasible to meet this rapidly increasing requirement, utilize every available technological advancement.

Requirements, Philosophies, and Trends

The increased demand for communications is expected to be particularly large between subscribers at geographically remote positions. There have been no significant technological developments except for a limited wideband cable facility in overseas communications in the past fifty years and, perhaps for this reason, overseas telephone messages have been only approximately one per cent of our domestic long lines messages. This small overseas traffic has been caused by high costs, poor quality, and long waiting times which the subscriber encounters when attempting to use these facilities. It is certainly apparent that all technological developments which can improve and increase global communication facilities are of particular importance. The rapidity with which the limited overseas communication channels have been saturated is an

indication that the main deterrent to increased global communication is the paucity of suitable facilities.

Large proportions of the expanding communication needs are required by complex military systems which depend for their operations upon the reliable transmission of huge volumes of data between centers and periphery points. Sources producing huge volumes of data and sinks operating upon and utilizing huge quantities of data are already in existence; the only remaining void is the wideband communications link necessary to connect these collection and data-processing centers. Accordingly, more and more demands will be made on the supplier of communications to provide the required links with the necessary reliabilities and at a low cost.

It might be well to consider first the manner in which the basic characteristics of communications have changed during recent years.

If there were equal interchange of information between all members of a population, the communication requirements would be given by a binomial coefficient of n people taken two at a time with repetitions allowed. The communication requirements under these conditions would, even for a small population, increase enormously. This equal interchange, however, would serve no useful purpose unless the data flow did not saturate the subscriber, and if all

subscribers possessed the same intellectual standard and educational background. Since this situation is a highly improbable one, organizations must find other means for producing results requiring coordinated effort on the part of many individuals. This quest, the very basis for proper organizational management, is of particular concern to all military and civilian large-scale efforts.

Organizations are able to produce results which come about by the combined, coordinated efforts of many individuals and by the use of facilities which can economically be justified only by large-scale ventures. A further characteristic of an organization is that the functions must be selected so that there is no duplication, or only a studied duplication, of the duties of any two individuals. This is one principle of management. A second principle, and also an important one, is that the decisions made by members of an organization must be weighted so that the most capable people make the most important decisions. As soon as we subscribe to this latter principle, we immediately introduce into the communication problem the concept that certain bits of information are more important than other bits of information.

Oftentimes the basic difference between the successful and the unsuccessful organization lies in the ability to utilize supporting technologies,

procure plant, and properly invest capital so that the mission of the organization, either civilian or military, can be accomplished within the limitations of the systems communications. This important requirement is often overlooked as the organizational structure becomes more complex. Large civilian and military organizations must, therefore, make certain that the design of the communications networks upon which they place so much reliance is considered as a system design problem in conjunction with their other operations.

Future communication requirements must also consider the supply of wideband facilities to the consumer, so that organizations can utilize and share central data processing machinery which would otherwise be economically unjustifiable.

The requirements and facilities for civilian and military use must provide communication with various orders of reliability under all conditions of harassment from natural

and man-made sources. In addition, the consumer must be permitted to select the reliability commensurate with his requirements by suitable control over terminal equipment including, perhaps, the modems and terminal encoding apparatus. Such proposals as the AT&T Telpak are particularly suited for this latter purpose. To furnish these facilities in an expanded manner, not only domestically but on a global basis, the communicator must anticipate and consider technological changes and their best application to his problems.

An indication of the trend in the increasing demand for communication facilities is presented in Figure 1. It is expected that there will be approximately a doubling of the overseas telephone messages within the next five years. This prediction, however, is based on certain assumptions as to a moderate increased availability, convenience, lower costs, and some new uses. Past experience has shown that consumer requirements

have always increased more rapidly than anticipated and that the ingenuity of the inventor has always produced more new uses than anticipated by the supplier. An aid to the anticipation of the probable trend is to consider the present ZI traffic and to examine whether the constraints which differentiate local traffic from overseas and foreign traffic can be overcome. Considerations such as guaranteeing of U.S. capital investments in South America, the simplification of customs procedures, changes in tariff structure, increased and improved low cost transportation immediately produce a greatly increased demand for communications. The consumer generally does a wonderful job of finding a new use for a transmission facility once it is provided for him.

The present overseas circuits leaving the United States via cable and radio total approximately one megacycle of information bandwidth. We may expect some immediate increased demands, particularly from the military, when the implementations suggested by many responsible groups for satellites with space bands from one to twenty megacycles are achieved.

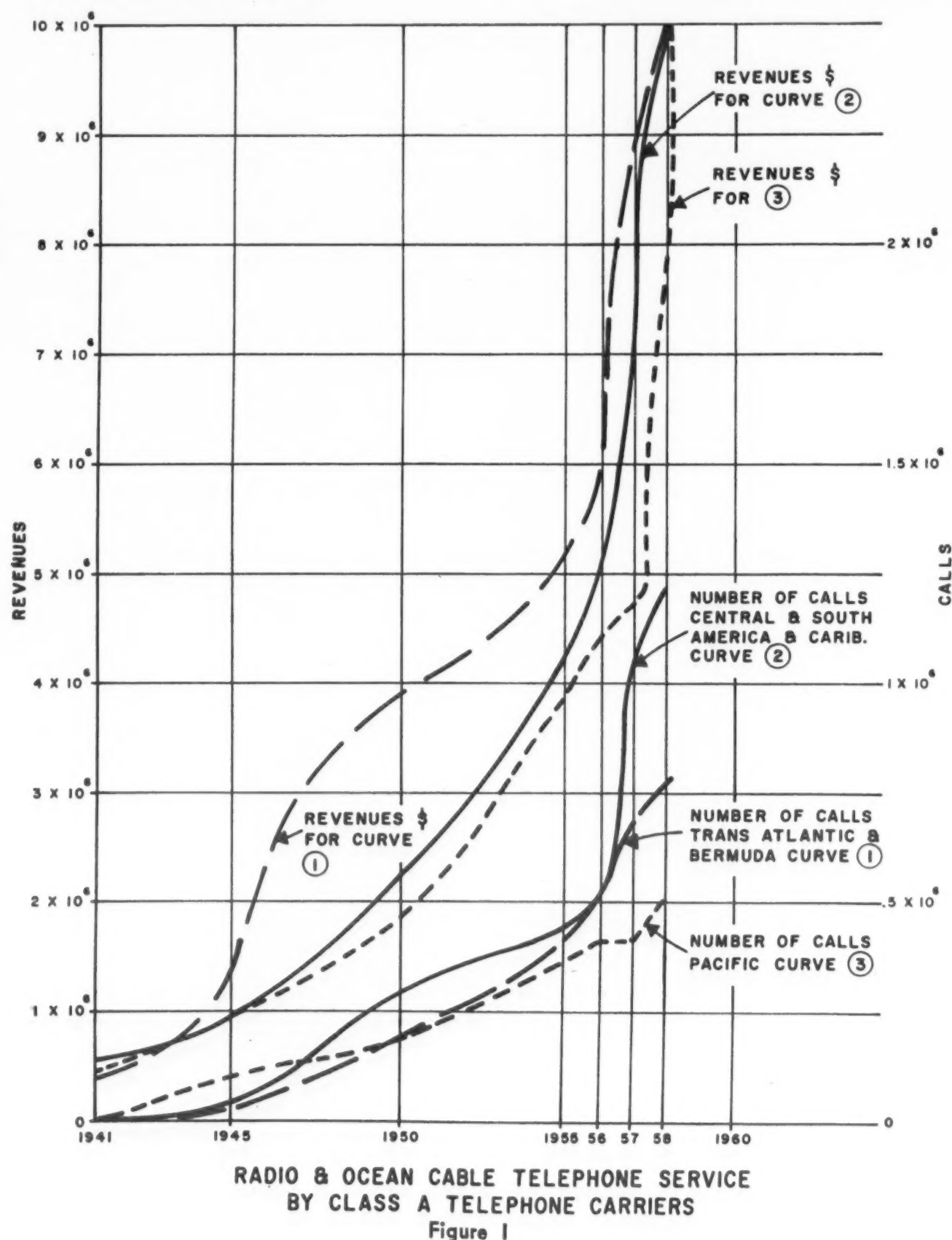
Let us examine briefly what possibilities the communicator has to utilize imminent technological changes in assisting him to solve his problems.

Increased Reliability

For the purpose of this brief discussion, this generic term may include communication system reliability and survivability, and communication security.

The first of these, communication system reliability, is defined as the degree of operability of the system under various conditions. This may be measured also in terms of the composite failure rate of individual component parts and assemblies or of circuit availability for multi-channel systems such as tropospheric scatter and line-of-sight radio relay systems.

Survivability is defined as the ability of the communication system to continue to exist and perform prescribed functions after exposure to man-made phenomena which tend to destroy, disrupt, or degrade the system. Included in this category are physical damage, interference, and other ECM activity such as jamming, sabotage, chemical and biological warfare. Communication security will not be covered at this point but, in general, involves the ability to communicate from one point to another



without having the message disclosed or available to unauthorized sources.

A collective reliability required due to the importance of decision of four to ten orders of magnitude may be involved. As an example, the decision to wage war which would involve an expenditure certainly greater than our gross national product for one year, by comparison with the average family income, gives us one indication of the ratio of the importance of a decision affecting the nation as compared to one in which only a family unit is involved. In similar fashion and resulting in similar ratios, we can compare the mortality resulting from a general conflict to that which occurs as a result of a decision made by a common subscriber. These and other criteria may be used to approximate the type of reliability considered sufficient to carry a message involving decisions of global importance. The capability of a communication system to sustain the composite reliability necessary to carry the most important decisions with the high degree of certainty and freedom of error, and to do this under catastrophic destruction, poses many interesting problems. These are extreme conditions, however. In the intermediate category, we find that greatly increased

reliability must be provided to sustain a host of new subscriber activities in political, medical, business, and other areas. As a matter of fact, a future growth of many of these uses will be seriously handicapped by inadequate communications. By inadequate communications, it is not intended to imply that this involves the common carrier exclusively, since the distribution of messages at the terminals and within the terminal area is presently one of our weakest links.

Modulations, Coding, and Data Processing

The demand for increased communications may, as has been indicated previously, be met by the utilization of a wider portion of the electromagnetic spectrum. Another attack to the problem is to consider methods and ways of utilizing more efficiently that part of the electromagnetic spectrum in common use today. This may be done by devising means for more advantageously using bandwidth for the transmission of greater amounts of intelligence per cycle per watt of power. This possibility leads to the utilization of new types of modulation and encoding processes. In this type of study, there are two major considerations. The

first is an investigation of modulation and encoding processes which, from a theoretical viewpoint, offer promise. The second is to view these theoretical attacks critically to determine at an early stage which ones offer promise towards the ultimate embodiment into practical and useful equipment.

From a theoretical viewpoint, there is an almost inexhaustible number of new encoding processes and new proposals for novel modulation schemes. However, few of these can be realized as practical equipments because of component unreliability. It is also possible to show that encoding methods can be and have been conceived to permit signaling at rates arbitrarily close to the capacity of a channel and with an arbitrarily small probability of error. Nevertheless, few of these encoding processes are attractive from the practical point of view for the large bulk of communication traffic. Many of the special codes, such as the parity check codes, are extremely useful for the higher priority messages where an increased cost of monitoring and maintenance is justifiable.

Until such time as the reliability inherent in components is increased substantially, many communication engineers believe that they must re-

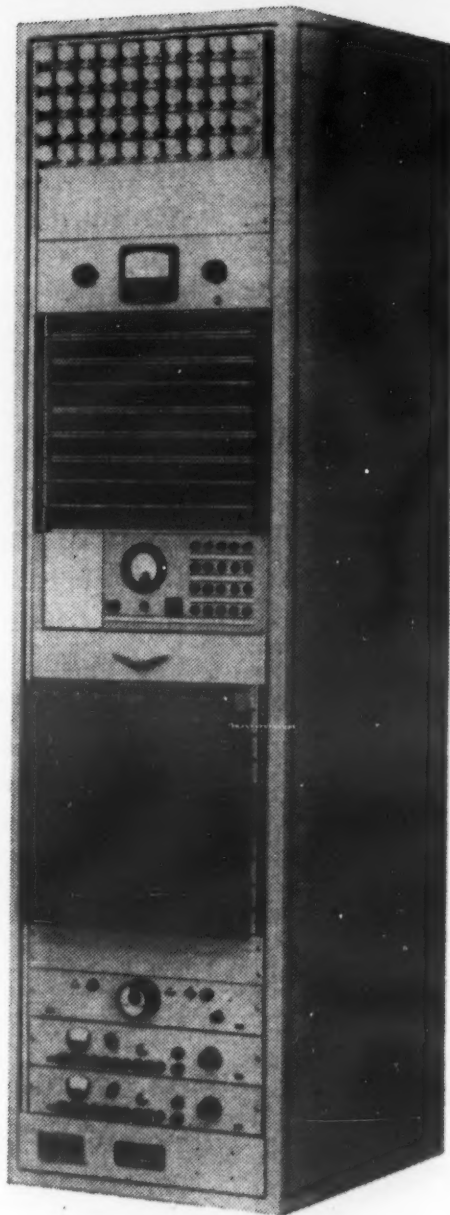
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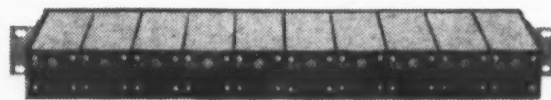
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vert to time-humored solutions such as reiteration. This retrogression philosophy is a result of considering the error reduction problem on a global basis and the additional capital expenditures necessary to introduce complex encoding equipment on a large scale basis.

In addition to the reliability and cost considerations, one must realize that oftentimes the premises upon which the theoretical considerations are based are derived from simplifying assumptions as to the statistics associated with the error-producing sources. As an illustration, consider a transmission link using the tropospheric scatter phenomenon. A 1 kw installation will cost in the neighborhood of \$25,000 for the transmitter, including power supply. A 10 kw installation will cost approximately \$75,000 to \$100,000 more. The variations in signal strength which may be encountered in one week of operation in a typical Mediterranean area installation is 40 db while seasonal variations of as much as 70 db are possible. This requires an encoding process which will improve the operation under certain levels of ambient noise and propagation anomalies of 70 db. Since the capacity of the channel under these extremes of signal-to-noise ratio is subject to wide variation, it is difficult to conceive of an encoding process which will substitute for reserve power in the transmitter. In most considerations of encoding and operation in large ambient noise backgrounds, the disturbances are considered to be Gaussian in nature. Further gains in combatting noise and in minimizing errors due to propagation phenomena must rest in obtaining more precise statistics relating to the perturbing influences and in devising methods of modulation for operation in this environment. The operation and encoding methods should be selected so that they can be physically realized without complex circuitry or loss of reliability.

Terminal Complexes

One of the most important contributions that the communications engineer who is considering the global communications system can make is the setting up of standards and encouraging their use in the terminal area complexes. The setting up of standardized character and bit rates; the recommendations of compatible signaling and supervision; the establishment of message formats, message lengths, levels, rates, modulation modes are a few of the standards necessary to assure com-

patibility on a global basis. These standards must be selected so that the traffic sources and sinks can be accommodated. Such sources and sinks may be: (a) Telephone, (b) Teletype machine, (c) Magnetic tape terminal, (d) Card transceiver, (e) Compound terminal (teletype card transceiver facsimile), (f) Telephone and data (G/A-SG), (g) Data (low-, medium- and high-speed computer sources), (h) Television devices, and (i) Analog sources other than telephone.

Switching

Introducing switching techniques which operate more rapidly than the mechanical types such as step-by-step and crossbar systems offers some possibility for more efficient utilization of existing facilities. These objectives may be realized, at least to some degree, by high speed switching.

(a) It is possible to obtain a more rapid user to user connection, that is, provide a fast reaction time, by rapid switching. This objective has not been considered an important factor in the past since few communication networks would be handicapped if this reaction time were greater than 5 to 10 seconds. However, with the coming of wideband switched circuits transmitting huge quantities of data and operating between data processing centers, a 5 to 10 second switching time may necessitate allocating lines unless high speed switching can be provided.

(b) A second objective of high speed switching is to increase the trunk efficiency or the utilization of trunking facilities. The efficiency with which a trunk is used is determined by the ratio of the effective communication time to the setup time, that is:

$$E = \frac{t_m}{t_m + n_c (t_{sl} + t_{sw})}$$

where t_m = mean message time
 n_c = number of centers in tandem
 t_{sl} = signaling time
 t_{sw} = switching time (one center)

The denominator in the formula for efficiency may average approximately 120 seconds when using crossbar switching. For voice transmissions, this is satisfactory, but when operating with wideband data, large quantities of messages may be involved with holding times of 1 second or less, so that the efficiency with which trunks are used would be decreased to a point where high speed switching would be economically

justifiable. A high trunk efficiency may also be obtained by proper traffic regulation by utilizing better program queuing programs or store and forward techniques.

(c) The utilization efficiency of the network can also be affected by the rapidity with which internal control is performed. Crossbar systems may have a total switching time long enough to make it impossible to use a single control marker, thus necessitating the use of several markers. In a fast matrix system, such as those using reed relays or semiconductor crosspoints, the speed is such that a single marker will suffice. Calls may thus be handled one at a time. This enables much more complex control operations to be performed with simplicity and increases the flexibility of the system. With representative message lengths, signaling times, and switching times for a three-center overall setup, and with representative marker holding times, a simple crossbar marker may handle about 30 calls per minute. A reed relay marker may handle about 1000 calls.

The implementation, therefore, of more rapid switching apparatus will be particularly effective in increasing the efficiency of utilization of existing facilities for the transmission of data and wideband, short duration messages.

Summary

Proper systems engineering of global communications is of extreme importance if reliable, economical, and survivable communications are to be maintained on an integrated global basis. It is anticipated that there will be major expansion in communications external to the ZI and between the United States and external points within the next five to ten year period.

A substantial increase should emanate from Europe to the other parts of the world. Probably three billion dollars of additionally invested capital may very well be required within the ZI to assure the communication needs of systems dealing with various phases of military operations, including offensive warfare, defensive warfare, intelligence-gathering, supply and logistics networks, and over-all coordinating command. The increases of operational dependence of the military upon proper communications, and the increase of civilian global communication requirements make the function of systems management on a global basis most important. This category of global communication system management demands increased attention from the communicator.

THE MANAGEMENT AND IMPLEMENTATION OF INTERNATIONAL COMMUNICATION SYSTEMS

SPEAKER: K. ZITZMAN, MANAGING DIRECTOR, INTERNATIONAL STANDARD ENGINEERING, INC.

WORLD-WIDE is a pretty ambitious term and it goes without saying that any system which deserves the title must be of an international nature and involve the specific type of problems which are inherent to international undertakings. Even if the world-wide system is for a completely United States agency such as the U.S. Air Force Project 480L which is being undertaken by ITT, it will still involve international dealing with many countries; for example, site authorization, frequency clearances, customs, interconnection with national communications systems, etc.

As systems become world-wide in scope, more sophisticated in capabilities, and more automated in operation, the complexity of their management seems to increase in logarithmic proportion. For the 300 million dollar Project 465L to provide the Strategic Air Command control system, ITT is the prime contractor, with 30 major subcontractors including some of the largest companies in the industry and I have no idea how many sub-subs there are.

Even with a single system manager answering to a single customer as is the case here, the managerial task is complex and difficult. The difficulties would be much greater, however, if that same project were of international scope such as the SHAPE tropospheric scatter communications project, ACE HIGH which is sponsored jointly by fifteen countries and has locations in nine of them. (See Figure 1.)

The international project involves not only the same technical and managerial difficulties as the other but is also subject to political and economic considerations particularly with respect to selection of equipment and its deployment between geographical locations.

The U.S. is involved in political and military alliances all over the world; NATO in Europe, the Central Treaty Organization (CENTO) in the Near East and SEATO in the Far East, to name a few. Large international communication-electronic projects have already resulted from them and we can expect more in the future.

The purpose of this paper is to point out the special considerations

involved solely by virtue of the project being international in scope and, in particular, being internationally sponsored. These observations and suggestions are based upon four years' experience gained on Project ACE HIGH.

In the first place, establishing an international project presents some unusual features. Any decision requires unanimous agreement among the parties concerned including a formula for cost sharing. Quite understandably each National Representative must study the proposals from the point of view of his own country. For example, communication links usually become part of the PTT system (post-telephone-telegraph system). NATO military pipelines augment national civilian ones or the requirements for both may be combined in a project financed jointly.

Navigational aids may serve civil aviation but if not, they must be thoroughly coordinated with the existing system.

Conversely, careful consideration must be given to the location of such projects as airfields which have no commercial application but take valuable land out of use, and missile bases which are prime enemy targets.

Then in carrying out the project, each National Representative must consider financing very carefully. It is only reasonable to expect that he will try to get an amount of money spent in his own country which is more or less in proportion to its contribution to the project. They also want to have work done in their own countries by their own citizens because of the fact that it is a source of revenue for reinvestment in the country, alleviates local unemployment, and simplifies security needs.

In carrying out large international projects, the concept of a single system manager responsible for the development, installation, and even operation of a large system as has been successfully employed in recent

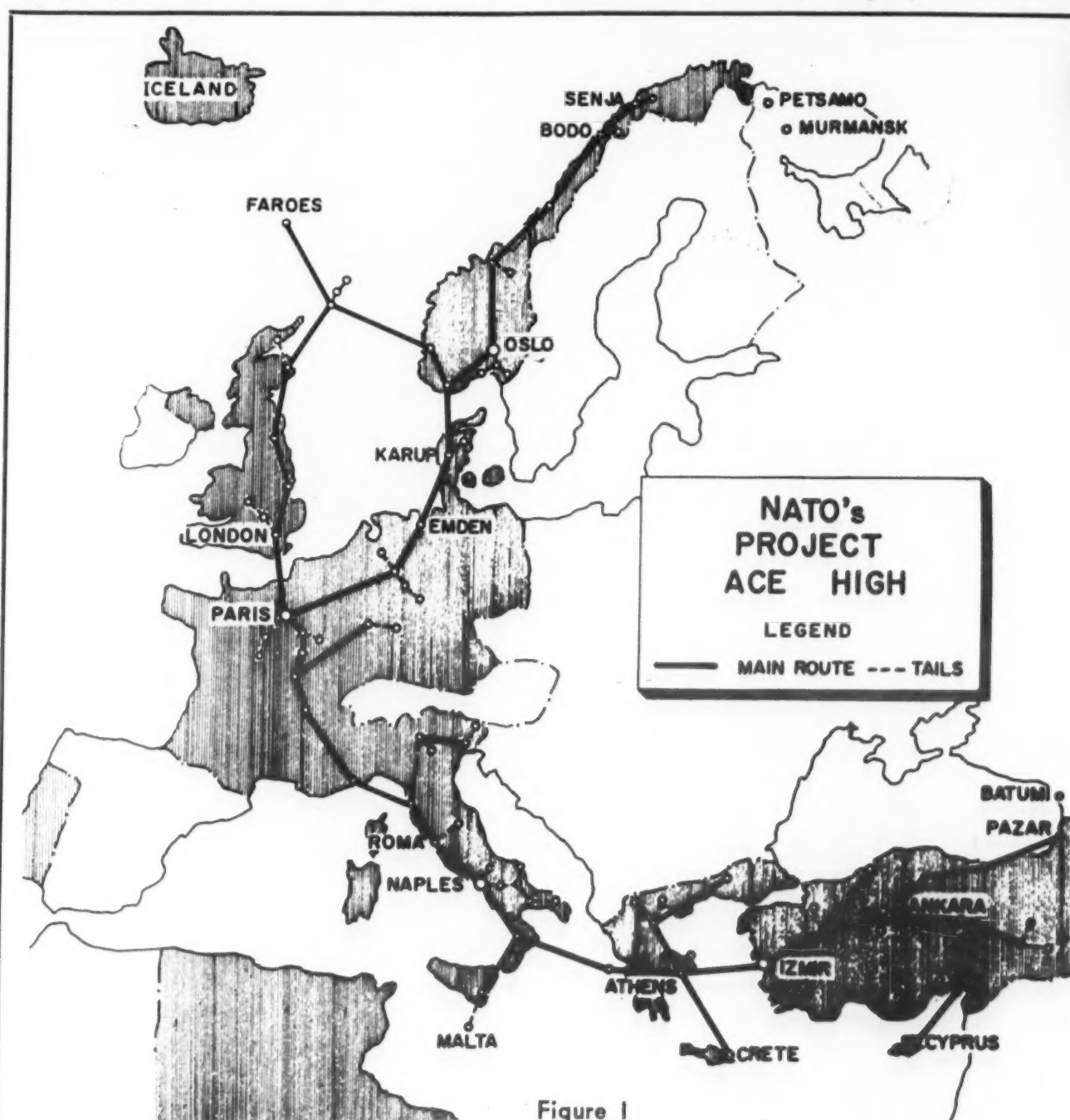


Figure 1

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years, is still the best. An outstanding example is the Distant Early Warning Line of radar detection and reporting stations across northern Canada.

For this vast project the planning, engineering, equipment procurement and installation were carried out by one major contractor—the Western Electric Company. Since then, the Federal Electric Corporation, a subsidiary of International Telephone & Telegraph Corporation, has acted as system manager for the operation, maintenance and logistic support for the DEW Line. The latter function includes not only engineering redesign, operation and maintenance, but everything down to the purchase, delivery and preparation of the food for the military personnel operating the stations.

The European countries are wary of this concept in principle, however. They are afraid some foreign company will enter their country, usurp or ignore national prerogatives, disrupt their PTT systems which are all government-owned, and interfere with their television broadcasts. One side of SHAPE's ionospheric scatter link between Paris and Naples is down right now because of suspected interference with television in England.

Also, in an attempt to maintain a reasonable relationship between the money invested in the individual countries and the contribution that each makes to the project, there is a strong tendency to compartment the system geographically and for each to do its own share. On ACE HIGH the separate Ministries of Defense (MOD's for short) constructed the buildings on their own sites and also provided the power supplies. These latter were built to SHAPE specifications, but are of different types in each country.

This works satisfactorily for the power supplies but would become much more difficult and costly if the procedure were also followed for data transmission and multiplex equipment for example, or any equipment where there is a question of technical compatibility throughout the system.

Considering all factors: efficiency, economy, and political considerations, I would recommend a management procedure as it has evolved for ACE HIGH with certain modifications.

The problem is to follow the principle of a single system manager as closely as possible, while making the required adaptation to international financing. We are doing this on

ACE HIGH as follows. The over-all cost of the Project will be about \$75 million. To show how and where this is spent I shall separate the project into its principal components:

a. *Engineering & Management*—\$9.5 million

This covers the cost of operating the Paris Engineering Center of ISEI (International Standard Engineering, Inc.), about 110 people, for the length of the project. If any eyebrows are raised about paying this to an American firm for a European project, I point out that each participating country is represented on our staff, Americans are in the minority, and that we pay corporate and individual income taxes to the host country.

b. *Installation Service & Material*—\$8.5 million

This is automatically adjusted by virtue of ITT's fortunate position of having a company in every country except Greece where the work is done by one of our Italian associates. We subcontract for this phase of our work to our associates in the country concerned because we have very close working relations with them and they are thoroughly experienced in dealing with the PTT and other government officials. From the national point of view it is attractive because it assures that everything spent goes to a local company composed 100 per cent of nationals of that country.

c. *Preparation of Sites including Buildings, Antenna Foundations and Access Roads*—\$25 million

ISEI prepared engineering specifications for standard buildings and site layouts. It also surveyed the sites while the MOD's contracted with local firms to do the actual work.

d. *Major Items of Equipment*—\$24 million

This is the most difficult requirement to meet, i.e., to get the best equipment possible and have each country share in the production. Each

would like to produce its own equipment but requirements for uniformity or even compatibility prohibit this to a large extent.

One method of procurement which has many advantages and which is the one followed on Project ACE HIGH is to have all equipment of a particular category throughout the network produced by a single supplier. This reduces the number of different suppliers to no more than the number of (main) categories of equipment, obtains the benefit of quantity production, and, at the same time, provides an opportunity for different countries to participate in the equipment production.

Each supplier is selected by international competitive bidding. Manufacturers can usually combine or offer under license if this is advantageous to the customer.

All this may sound unnecessarily complicated but when financial people who probably have little or no communications experience get together for important decisions, the negotiations get tough. I recall some years ago when during a protracted discussion on one point the United States member said with some exasperation: "We are only talking about \$1 million."

To this, the representative of one of the tiniest countries replied: "Sir, that is 10 percent of our annual military budget."

In conclusion I think that the future will see closer and more extensive international collaboration in communications-electronics than ever before, particularly with the United States involved. I also believe that this is recognized by the people in important positions in friendly foreign countries.

Our Paris Chapter of AFCEA has more Frenchmen than Americans in it. This is because they recognize the benefit to be gained from the regular exchange of knowledge and experience. When I spoke on Proj-

ect ACE HIGH before the London Chapter, the advance notice carried a brief description of the Project and they had the largest attendance in the history of their Chapter. They certainly did not come to hear me but to learn about this network of which a substantial portion is located in their country.

One of the most critical problems in the military and in industry alike is the shortage of qualified personnel. Recently, Major General F. W. Moorman, Chief Signal Officer of SHAPE, proposed a program whose objective is to raise materially the level of electronic knowledge, and hence the availability of scientists, engineers and technicians who are so badly needed in the countries of the free world in general and NATO in particular. He presented this plan personally at a meeting attended by the Chief Signal Officers of the individual NATO nations as well as those of the NATO operational commands. He has also called it to the attention and asked for the support of General Norstad, the heads of all SHAPE Staff Divisions and the National Military Representatives to SHAPE.

To get the support of the agency which he considers the most powerful and helpful in this field, he wrote to Colonel W. J. Baird, General Manager of the Armed Forces Communications and Electronics Association, to ask for the backing of this organization. General Moorman's choice was sound. We have 12,000 members spread throughout the world, over 200 Group Members, and have active Chapters in 58 cities. The Regional organization now covers most of the globe.

The program will not proceed hurriedly. When the time comes and you are asked to participate in it, I can think of no better way in which you could enhance the cause of international, and hence world-wide, communications than to give it your wholehearted support.

CABLE SYSTEMS IN WORLD-WIDE COMMUNICATIONS

SPEAKER: F. FAIRLEY, TECHNICAL ADVISOR, ITT FEDERAL LABORATORIES

THE NATURAL EMPHASIS on the use of cable systems in a world-wide communications network lies in the geographical environment in which few, if any, alternative systems are available in the present state of the art to provide reliable means of communication, i.e., over large expanses of sea. It is therefore appro-

priate to concentrate on the achievements and potentialities in the use of submarine cable systems, but the large-scale application of land cable systems to the present day communications network both for long- and short-distance operation cannot be ignored.

The great technical virtue which

cable transmission has over all other forms of communication is the confinement of the signal within a highly stable medium of small cross-section almost entirely undisturbed by natural phenomena such as weather changes and static or by man-made electrical interference. Systems over land or short sea distances, such as

line of sight or tropospheric radio, have now been developed to the point where they largely overcome the effects of the transmission medium; and if properly planned, they approach the performance of cable systems and can take their place in a global network wherever environmental or economic considerations warrant. On the other hand, HF ionospheric scatter radio systems which today are the only practicable alternative to the use of submarine cables for long over-water paths have been unable, even with large capital expenditure, to overcome the defects of the medium to the point where they can approach the performance of cable systems. With the possibility of using outer space as a transmission medium by the use of satellites as repeaters or reflectors, many of the virtues of cable system transmission will be attained, and the choice of system, whether over land or sea, may well be dictated by reasons other than those associated with the technical performance of the resulting circuits.

Submarine Cable Systems Today

Figure 1 shows the major world submarine cable arteries existing or planned within the next decade for telephone or other wide band transmission. All the circuits shown crossing sea areas are provided by repeatered submarine cable systems. Cables for telegraph transmission on a global basis have been used for about 100 years and are still in use, being updated by improved telegraph techniques or by the insertion of telegraph repeaters to increase traffic capacity. The system designs for long distance repeatered submarine telephone cables have been established, and electronic circuitry, well within the state of the art to support these designs, has existed for several decades. Only in the last ten years have improvements in cable materials and laying techniques, together with increasing confidence in the reliability of components, made cables using submarine repeaters practicable. A major breakthrough in respect to global communications was made by the inauguration of the first trans-Atlantic telephone cable system in 1956 followed by a second in 1959. A third direct trans-Atlantic cable will be laid this year between Canada and Scotland, and a fourth directly between the U.S. mainland and England is projected for 1963. The success of the first long-distance repeatered cables has been such that, solely on return for capital investment, the major communications op-

erating organizations throughout the world will be laying submarine telephone cables at the rate of upwards of 10,000 nautical miles per year for the next few years.

The first trans-Atlantic telephone cables used coaxial construction of diameter 0.62 inches over the polyethylene dielectric and were heavily armoured. Two cables were laid, one for each direction of transmission over the deep Atlantic Ocean with U.S. repeaters, and this was extended over Newfoundland to the American mainland by a single cable using British shallow water repeaters.

The use of two cables, avoiding filters for separation of the frequency bands used for each direction of transmission in the repeaters, facilitated a flexible repeater housing little larger than the cable diameter, which simplified the laying problem in deep water since the repeaters could pass over the cable-laying gear without stopping the ship. On the other hand, the two-way repeater with its additional circuitry was housed in a rigid container and presented problems which had not then been solved for deep-water laying. Furthermore, the one-way repeater, using slightly less than half the bandwidth required for both-way transmission with directional separation in the two-way repeater allowed a longer repeater spacing for the same noise performance. This reduced the number of repeaters in the long Atlantic section and consequently reduced the voltage required for feeding power to the repeaters from the two shore ends. In turn, this allowed one of the largest repeater components, the capacitors in the filters separating the DC power feed from the transmission circuitry, to be reduced in size, thus facilitating the flexible housing.

The system has a capacity of 36 4kc/s spaced telephone channels using the frequency range 20-164 kc/s in the one-way repeater and 60 4kc/s channels using the frequency ranges 20-260 and 312-552kc/s in the two-way repeater. In each case, the frequency ranges transmitted were slightly extended to accommodate order wire and maintenance facilities. The one-way repeater has a gain of 65 db at the top frequency and is spaced at a nominal distance of 37.5 nautical miles, and the two-way repeater top frequency gain is 60 db and is spaced at about 20 nautical miles.

The system design of the second trans-Atlantic cable was identical with that of the first. The advantages of using one cable with two-

way repeaters instead of two cables stimulated further development and experimental work in the areas of (1) improved cable design to assist in the laying operation in deep sea with two-way repeaters in rigid housings, (2) repeater design and particularly tube design to reduce the voltage drop required for power feeding from the shore ends, and (3) design of cable machinery on board ship to facilitate the laying operation. The results of these activities are that the third trans-Atlantic cable "CANTAT" to be laid this year will use in the deep sea portions a coaxial cable of one inch diameter over the core instead of 0.62" with only two-thirds the attenuation and lighter in weight. This cable is comparable in cost to the earlier cables, largely due to the omission of heavy wire armoring by concentrating the strain member within the inner coaxial conductor. In addition to being lighter, this cable is also more flexible and does not rotate under the stress of laying, which greatly assists the laying of rigid repeaters. The repeaters will have a power feed voltage drop of 70 volts instead of 125 volts. This cable between Newfoundland and Scotland will cross the Atlantic with 88 repeaters (with some submerged equalizers) providing 60 4Kc channels with a nominal repeater spacing of 26 nautical miles and a gain of about 55 db at the top of frequency of 608 Kc.

Both cable and repeaters of a submarine cable system have been designed and manufactured to the highest standards of reliability with an expected life, if undisturbed, of the order of twenty years. To date, no failures of the long-distance system repeaters have occurred, but the trans-Atlantic cables have been cut by trawling operations off the Newfoundland fishing banks and, very recently, by damage from an iceberg. The deep water sections are practically immune from these effects and from wear on the sea bottom. Work to increase the distances which can be spanned by submarine telephone cable systems has resulted in the possibility today of covering distances of about 3500 nautical miles; this permits greater freedom in the choice of landing sites, and using suitable islands will enable repeatered submarine cable systems to cover the ocean distances involved anywhere in the world. Work to increase the channel capacity will today enable 96 4Kc/s spaced channels using line frequencies slightly greater than 1 Mc/s to be used. The TAT 3 cable to be laid about 1963 will have such a capacity

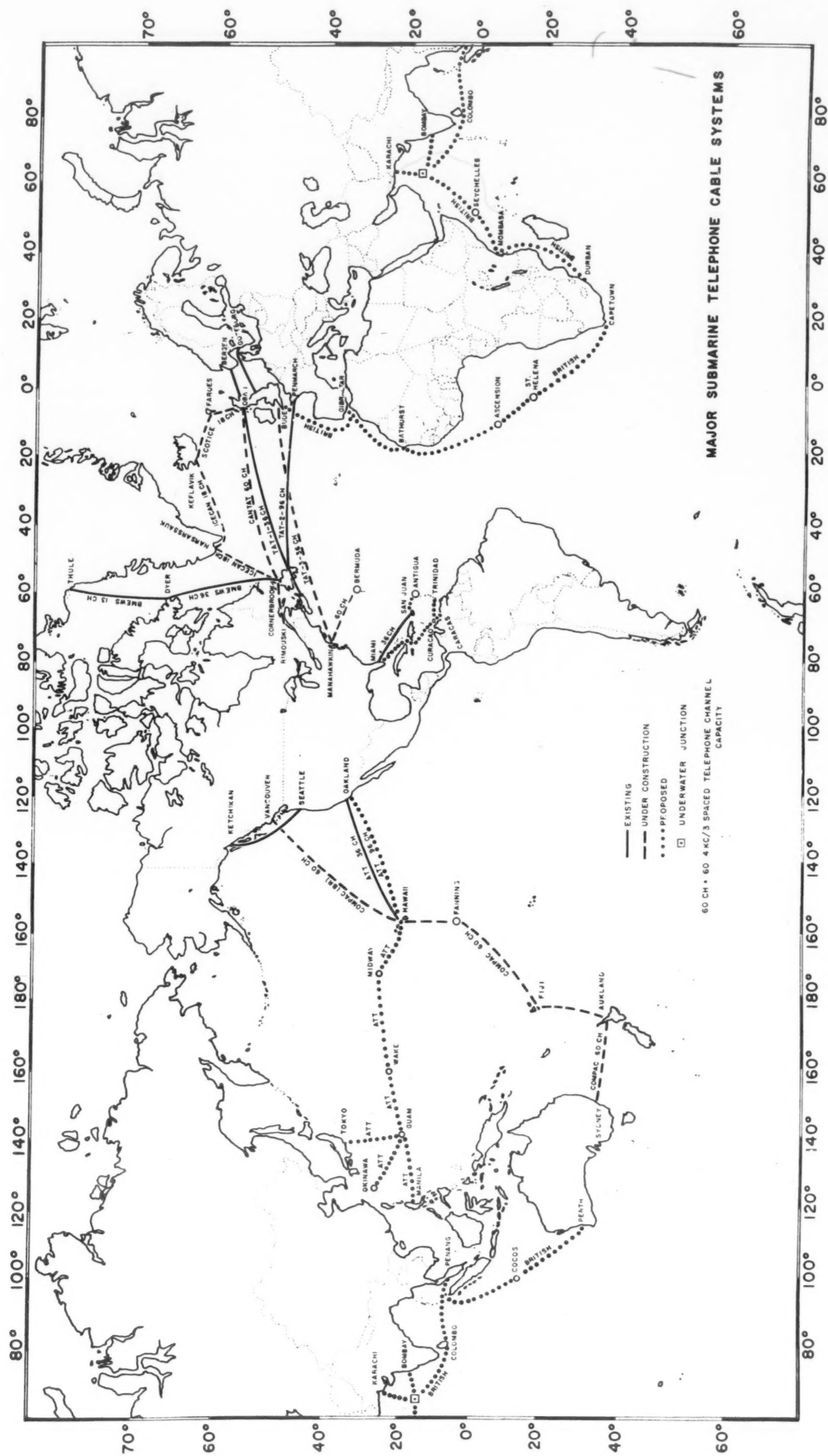


Figure 1

on a one inch coaxial cable similar to the "CANTAT" cable but with somewhat improved performance and will proceed directly from the U. S. mainland to England, thereby avoiding the main fishing and iceberg areas. The repeater spacing will be about 20 nautical miles, and up to 180 two-way repeaters will be required. About 6000 volts of DC power will be required at each end, but the problem of design of power separation capacitors will be eased by raising the lowest transmission frequency well above the 15-20 Kc/s previously used. Although the repeater will be mounted in a rigid housing, this will be smaller than previously used. As a result of intensive work in the design and provision of new cable laying gear, using caterpillar tracks instead of drums, the smaller rigid repeaters will be fed through the shipboard machinery along with the cable.

Although the greatest concentration of effort has been directed to the Atlantic because of the community of commercial interest, a 36 4Kc/s channel cable system using one-way repeaters was laid between California and Honolulu in 1957, and several minor cables have been laid or are in progress in various parts of the world. Plans are now being implemented for a single two-way cable known as "COMPAC" between Canada and Australia providing 60 channels, ultimately linking the major countries of the British Commonwealth. Other major plans under consideration by the Bell System will provide a network linking the U. S. to Tokyo, Manila, and other Far Pacific areas based on the system design in program for TAT 3.

Two developments of major importance affecting the circuit capacity of submarine cable systems have occurred since the first telephone transatlantic cable was laid. By an ingenious method of assembling the telephone channels in the frequency spectrum of the basic twelve channel group, sixteen channels spaced at 3 Kc intervals occupy the bandwidth of twelve channels at 4 Kc spacing with only a modest degradation of attenuation-frequency and envelope delay characteristics. The bandwidth effectively transmitted is 300-3150 cps instead of the normal 300-3400 cps. This multiplex equipment has already been applied to some twelve channel groups of existing cables, increasing the telephone circuit capacity by a ratio of 4/3 and will almost certainly be used on all future submarine cable projects. A second development, taking advantage of the relatively inefficient occupancy of the circuit by

actual telephone speech or signalling, known as TASI (Time Assignment Speech Interpolation), routes the communication over any vacant channel of the number of channels to which it is applied only while speech or signalling is in progress instead of allocating a channel exclusively for the use of a subscriber. In this way the telephone circuit capacity may be as much as doubled with only a negligible effect on performance. The cost of the terminal equipment required for 3 Kc/s spaced channelling is greater than that of conventional multiplex equipment, and the performance degradation although slight is likely to be noticeable with several links in tandem. Its application is likely to be restricted to long-distance submarine cables in which the cost of bandwidth for increased channel capacity is very high. This restricted application is even more probable in the case of TASI, in which the terminal equipment is very costly and where the effect of connection of links in tandem would be noticeable in performance and involve operational difficulties in controlling the link traffic loading to avoid lockout.

Future of Submarine Cable Systems

The most obvious advance in the state of the art of submarine cable systems lies in the use of transistors in the submerged repeaters instead of tubes. In view of the progress made in the development of all forms of electronic circuitry incorporating transistors and their use elsewhere in designs suitable for submerged repeater amplifiers, it is interesting to review the reasons for caution in the application of transistors to submarine cable systems. The fundamental philosophy behind the design of submerged repeaters has been the attainment of reliability such that the costly replacement of a repeater, with at least a few days' loss of circuit time, would virtually be eliminated over periods of the order of 20 years. The designs and manufacturing techniques of the major submarine repeater components have been well tried and proven in land equipments for many years, enabling the factors which lead to failure to be avoided. This is not true of transistors and of some of the components which surround them, such as low voltage, high capacity, capacitors of small size, to complete the circuit design. However, since the major influences which contribute to circuit breakdown are high voltages and local heat generation, both of which are considerably reduced when transistors replace tubes, there is considerable stimulus to accelerate the development and establishment

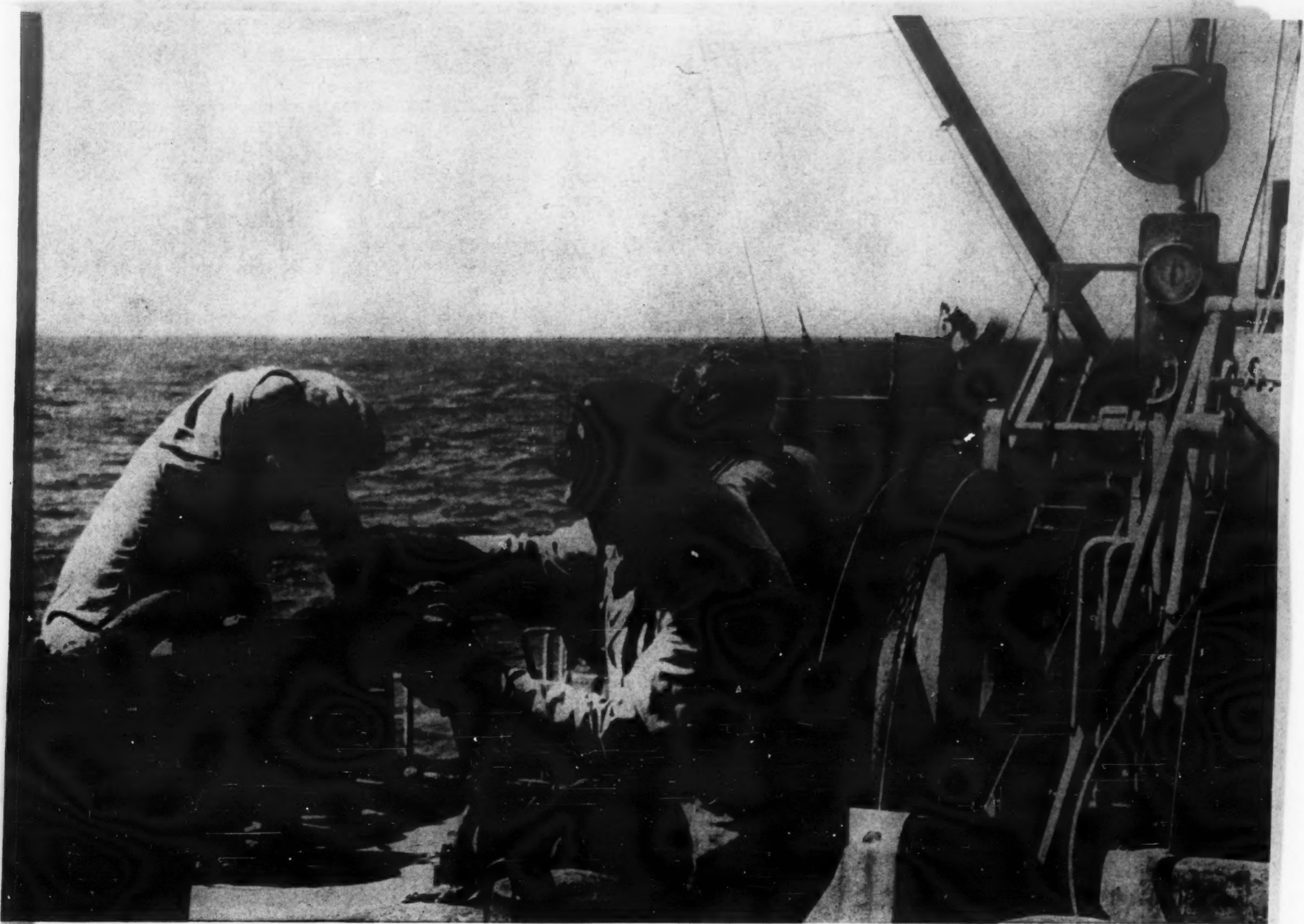
of confidence necessary to allow them to be used. Work is actively in progress to this end in several organizations, and within perhaps two to three years, one may foresee transistorized repeaters applied to submarine cables.

The inclusion of transistors and associated circuitry is unlikely to make a spectacular reduction in size of the repeater since the components of filters, equalizers, etc., will not be affected. The major effect will be that the power feeding and power separation problems will be considerably simplified. However, any reduction in size will allow more repeaters to be stored on board ship and will facilitate the laying operation. This will make more feasible the reduction of repeater spacing and consequently increase the bandwidth available for transmission. This should considerably reduce the cost per channel mile of submarine cable systems.

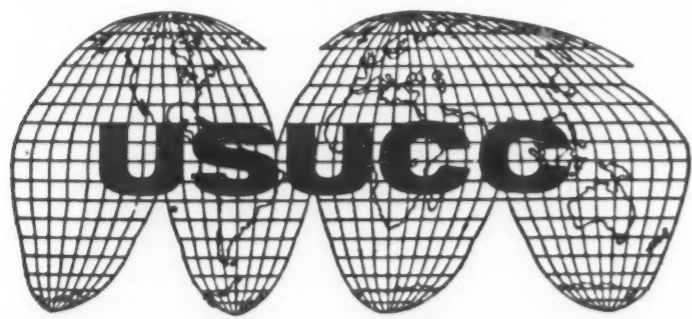
The early submarine cables used gutta percha and later paragutta, two rubber-like substances, as insulants. Polyethylene made a major step forward in reducing attenuation, and the omission of armouring reduced the cost and ease of handling. New dielectrics may be evolved in the future with even better electrical and mechanical characteristics than polyethylene. One may envisage techniques for the inclusion of air or an inert gas as part of the dielectric even at the great depths of the oceans, thus further reducing the attenuation and permitting wider bandwidths.

As previously mentioned, the increase in distance capable of being spanned by submarine cables, giving flexibility in the choice of landing sites, should enable the major hazard of submarine cable systems, which is accidental or deliberate damage of the shallow water sections, to be reduced. Further attention to this hazard is being given, and the possibility of ploughing the shallow water sections into the sea bed is being considered. An alternative, and probably less difficult, method would involve the development of a submerged junction device so that the shallow water sections could be brought ashore by two or more independent paths. Cutting any one of these paths would not put the cable out of operation.

Some of the cables foreseen in the next few years will include nearly 200 repeaters in a single ocean section. To design a system with the linearity of characteristic demanded for wide-band operation, a very accurate knowledge is required of the cable section and repeater parameters to ensure a good match, and



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these parameters must be accurately controlled during manufacture and laying. Errors tend to be systematic, and this requires great accuracy and stability of test gear, and in addition, the inclusion of submerged equalizers designed and made up on board ship to suit the actual characteristics of the repeatered cable as laid. At present there is an unexplained slow reduction in attenuation of the cables laid a few years ago; and although this appears to be approaching the asymptote, it must be eliminated or taken into account in future planning. These factors may well determine the rate of progress in the submarine cable field as the distances, number of repeaters and useful bandwidth are increased.

Submarine Cable System Costs

Many factors, other than the cost of the submarine cable and repeaters, influence the over-all cost of a submarine cable system. The landing points must be connected to the main centers of traffic distribution at each end and the cost of this varies considerably depending on the geographical location of these points and on the need to up-grade or to provide new land system facilities at the time of opening the service.

The TAT 1 cable cost about 42 million dollars. It used two cables and provided 36 4kc spaced circuits most of which were between New York and London, a total route dis-

tance of the order of 3900 nautical miles. The over-all cost per circuit nautical mile was therefore of the order of \$300. This has of course been reduced by the use of 3Kc/s space circuits and TASI.

The TAT 3 cable, directly between the U. S. and England, a distance of the order of 3600 nautical miles, would provide 96 4Kc/s space circuits, and the estimated cost is 34 million dollars. The cost is therefore expected to be about \$100 per circuit nautical mile.

With the advent of repeaters using transistors of suitable reliability and performance, which could be expected to be available within the next few years, the cost of submarine cable systems could be expected to be reduced to some \$30 to \$40 per circuit nautical mile.

Progress in Land Communications Cables

The heavy capital investment in land cables has stimulated developments to make more effective use of the cables already laid or to reduce the cost per circuit mile of future cables. Some recent developments are of interest in this connection. In the long-distance field the effective bandwidth of coaxial cables has been increased in the U. S. to slightly over 8 Mc/s by the use of the L3 system with repeaters spaced at half the original distances. In Europe where the repeater spacing in the original

cables was 6 miles instead of the 8 miles in the U. S., a similar action has extended the bandwidth to 12 Mc. By these measures the circuit capacity has been increased nearly threefold or alternatively the cable use has been extended to include television and telephony in the same repeaters.

In the medium-distance field many carrier systems, the most widely used of which is the N1 system, have been evolved to extend the useful frequency range of cables originally planned for audio frequency use. For new cables over medium distances an interesting development is the small diameter coaxial cable using expanded or "blown up" polyethylene as dielectric. This cable is equipped with power-fed transistorized repeaters located at distances of the order of 2½ to 4 miles and installed in manholes or buried pots. It provides three hundred 4Kc/s circuits over a pair of tubes or 120 circuits over a single tube and often will prove economical compared with line-of-sight radio or other means as a spur network to the main coaxial or radio link routes. This cable system is finding considerable application in Europe, although so far has not been used in the U. S.

Global Use of Cables

The system designs of the world's telephone and telegraph cable circuits in the last two decades have been based on the recommendations of the International Telegraph and Telephone Consultative Committee (CCITT) and of the Bell System. The CCITT has postulated for guidance a Hypothetical Reference Circuit length of 1500 miles with a link constitution typical of the make up of international circuits in the European continent. The Bell System has based its designs on a circuit length of 4000 miles, and the transmission performance in general approximates to the performance of a circuit of equal length based on CCITT recommendations. Long-distance circuits planned to these guiding principles have resulted in networks which, if properly maintained, have proved to be very satisfactory for speech and telegraph communications within a continent.

The more important parameters specified for telephone communication (which also are satisfactory for telegraphy when the telephone circuit is subdivided by telegraph multiplexing) are weighted noise at zero relative level in the telephone channel band-maximum 5 picowatts per mile, bandwidth effectively trans-

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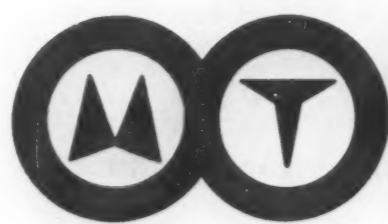
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mitted —300 and —3400 cps, stability ± 1.7 db and reference transmission equivalent between subscribers in a continent —40 db maximum. In formulating these recommendations, little attention has been paid to parameters such as transmission delay, envelope delay distortion and impulse noise to which telephony and slow speed telegraphy are comparatively insensitive. With the growing demand for the transmission of medium or high speed data, future cable and other systems will be designed with the requirements for this form of communication very much in mind.

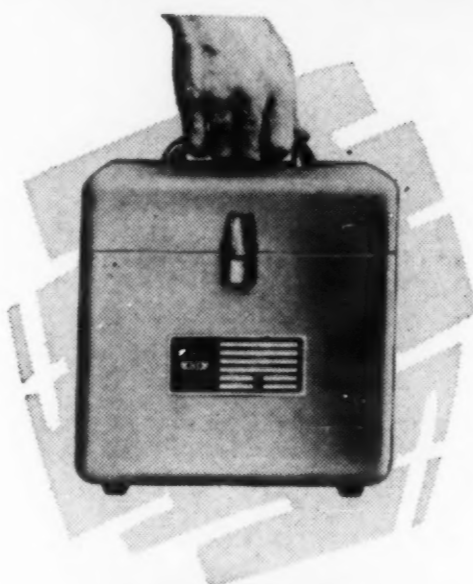
Continental networks planned to present recommendations do not necessarily produce good intercontinental communications on a global basis since the intercontinental links, even with submarine cable systems, must introduce noise, distortion, and instability. The trans-Atlantic links hitherto have been planned with noise in the worst channel of 5 picowatts per mile, half CCITT limits for attenuation-frequency distortion between New York and London, and standard deviation of net loss on the over-all circuits made up of radio, sea cable, and land cable links between New York and London of ± 1.5 db. Experience has shown that these trans-Atlantic links have given very good over-all performance with telephony and telegraphy over the major regions of the two continents served, even with the slight narrowing of the band with 3 Kc spaced channels and with the application of TASI.

However, the possibility of global communication over distances of the order of 15,000 miles whether by submarine cable or satellites has recently focused attention on the suitability of present-day objectives for continental and intercontinental links in meeting the requirements. One immediate result is that the planning objectives for the "CANTAT" and "COMPAC" cables will be mean circuit noise 1.6 picowatts per mile averaged over all channels at a point of zero relative level and standard deviation of transmission loss of 1.8 db for over-all circuits (including London, England, to Sydney, Australia, a route distance of 16,000 miles).

Although upgrading of the performance objectives of new long-distance submarine cables can be done at not too great a cost per circuit mile, the cost of general application of improved objectives to continental or national networks would be prohibitive and render obsolete many



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existing systems before the end of their useful life. It is probable, therefore, that global communication will be attained by selecting the best continental and national circuits which will be segregated in the national switching plans for global use.

The circuits will be selected from those showing the greatest reliability, low noise and high velocity and will be derived from coaxial or carrier cable systems and the better planned radio links. Loaded audio cable circuits, still in use in many parts of the world, will tend to become obsolete except for local communication.

One of the most important steps to be taken in adapting present networks to global communication is the routing over long distances of through groups or even supergroups where the demand exists. This will avoid the noise, transmission delay, and distortion introduced by intermediate multiplex and switching equipment. Over-all stability can be maintained by the use of automatic pilot control of group and supergroup transmission level. If through group or supergroup working does not attain satisfactory terminal conditions as regards attenuation-frequency or envelope delay distortion for global operation, this can be im-

proved by the application of appropriate equalization at these points without too much cost for the limited number of circuits involved.

Experience will show whether what can be done with existing equipment and techniques is good enough for global communications. Distance will certainly not improve performance, and this directs speculation to forms of transmission, using for example pulse code modulation, where complete restoration of the signal is possible before it becomes too degraded by noise or distortion to be recognizable. Pulse code modulation is now being actively developed for telephony use in short-distance local area cables because of possible economies in the cost of terminal equipment compared with frequency division and where the large bandwidth required is available and not too costly. The techniques are suitable for data transmission and regeneration will be used at suitable points in this form of transmission on a global basis. Techniques of vocoding are rapidly advancing. The transmission of speech without cumulative distortion on a global basis and without requiring prohibitive bandwidth is already a possibility and might well in the future include the talker

voice recognition, which is one of the main virtues of telephony.

Conclusion

Although today the attention of communications engineers and of the more advanced telephone operating organizations is focused on the more exotic forms of long-distance communication systems, such as satellite links, the proven reliability, freedom from interference and limitation of access of long-distance submarine cables is likely to justify these for the main global communications links for many years. Even when all the problems associated with satellite launching into orbit and performance have been solved, cable links will take their place in the world network on an equal or better performance basis than the best satellite circuits and with fewer international problems than those involved in agreements for the use of space.

A land cable network will always be required whether to coastal landings or satellite transmitters, and the future continental cable networks will be planned and the present ones updated to make their correct economic and performance contribution to global communications.

SWITCHING REQUIREMENTS IN WORLD-WIDE COMMUNICATIONS SYSTEMS

SPEAKER: R. L. PLOUFFE,* FORMERLY DIRECTOR, DIGITAL SYSTEMS LABORATORY, ITT FEDERAL LABS.

WE ARE ALL AWARE that in recent years there has been a tremendous growth in the requirements for military communication. Existing facilities are required to be modernized and new facilities are being planned to meet the need imposed on us by the political-military environment in which we find ourselves. The enormous effort required to meet this need is being planned by a number of different agencies and being carried out by several members of the telecommunication industry. Our patriotic and moral senses tell us that the required expansion ought to be achieved in a manner to meet the need not only in the time frame required but also so as to require the least expenditure of funds. In some cases, these two objectives may not be compatible; however, their cause could be materially aided if industry were provided with or could agree on a set

*Now VP, Dir. of Engineering, STELMA, Inc.

of guidelines founded on an appropriate technical requirements base.

To some extent a proper examination of the technical requirements base would set the stage for future standardization. It is not desired to set standards which will bind future generations but some standards must necessarily be set in order to achieve an orderly growth of our military communication facilities. Compatibility is the key objective required to achieve an orderly growth. A complete examination of the technical requirements base is not possible in the short space of this paper, nor will I pretend that I could make the complete examination. This is a task for the entire telecommunication industry and the military services.

This paper will concern itself with some of the considerations felt important in switching systems—although it is difficult not to also bring in some transmission considerations. The two together form the heart of any communication system and, in

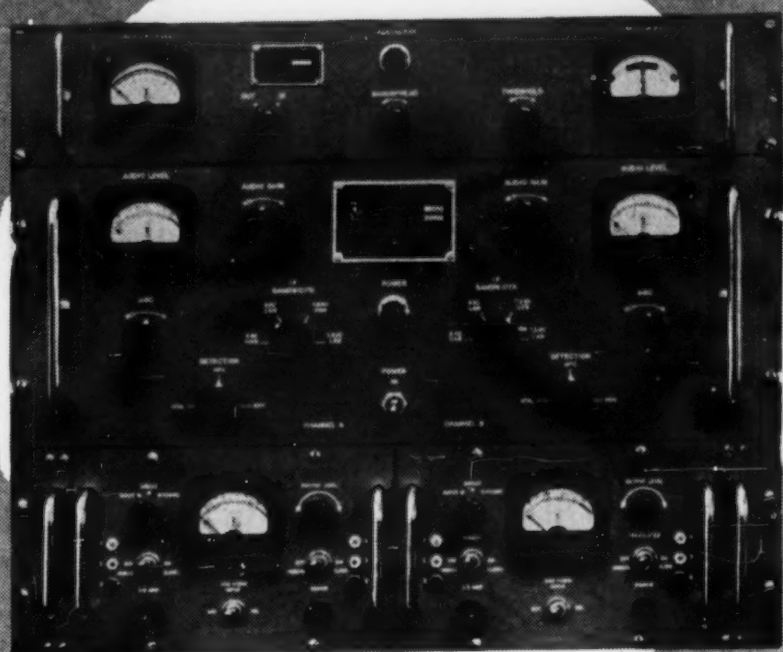
many cases, are inseparable. It is recognized that certain standards are in existence today. Without these standards, the vast facilities of the commercial common carriers in this country would be virtually impossible. However, these standards have been set and have served admirably for a system designed largely to handle voice telephone messages. Even in this system, if one were to ask what a "standard" or "normal" telephone channel is, many knowing eyebrows would be raised. Fortunately, this is not an important question to ask if the system is required to handle only voice messages.

One of the principal elements of the technical requirements base that needs proper examination is that there is a fast growing use and need for digital forms of communication. Even many messages handled in the voice mode today could be better delivered by a digital mode. The question that needs answering is, what

(Continued on page 54)



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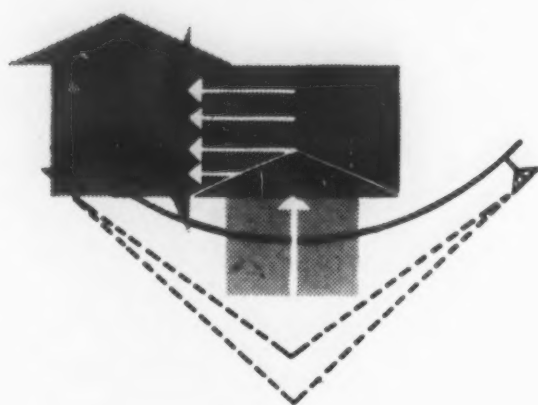
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standards should be set in order to allow the design of an efficient system for handling this growing form of communication traffic? Much work has been done on attempting to answer this question by several military and industry standards committees. However, the adoption and interpretation of these standards leaves much to be desired. Full adoption of appropriate standards can have important economic effects on switching equipment design and lead to basic compatibility between various systems. For example, the adoption of equal length binary elements and transmission rates in a geometrical progression from some base rate (say 75 bits/second) together permits efficient time division multiplexing of the signals. This further permits multiplexing and circuit switching functions to be combined in one equipment. To achieve this objective, it is desired that the rates established in a geometrical progression from 75 bits/second be considered "standard" for both the transmission and circuit switching equipment. However, one finds that this is not always the interpretation given to standard bit rates. Any digital signals required for synchronization, signalling, and error correction should be included within the standard rate. Any other interpretation will lead to a non-optimum system configuration.

The considerations given above lead to system simplicity and, therefore, should be standardized as soon as possible. The questions of synchronization, signalling, and error correction are important from the standpoint of intersystem compatibility and should be attacked as soon as possible if compatibility between systems is ever to be achieved. The most difficult of these is the matter of error correction because of the exigencies of various transmission channels. However, sometimes we can avoid difficulties by recognizing the technical facts. The fact is that different transmission channels or media will always be different, and to obtain any desired degree of transmission accuracy, each media or channel will have to be handled differently from the standpoint of coding for error correction. Therefore, this is a transmission problem and no standards should be set that apply to an over-all system.

Another primary element in the technical requirements base is the matter of choice between circuit switching and message switching or the appropriate combination of the two. Circuit switching is virtually

mandatory where a requirement for a two-way instantaneous conversational mode of communication exists. Beyond this, the choice between circuit switching and message switching is largely an economic one. Switching is introduced into a communication system in the first place basically for an economic reason—that is, to efficiently utilize transmission facilities. When a two-way instantaneous conversational mode is not required and particularly when short holding time traffic is handled, such as is generated in Command and Control systems, then message switching is inherently more capable of efficient utilization of transmission facilities. It is necessary to strike an economic balance in deciding how much direct or circuit-switched facilities and how much indirect or message-switched facilities to provide. There is a tendency to permit much traffic which basically could be handled in the indirect mode, to be handled in the direct mode because of the relatively high cost of message switching equipment. However, it is felt that this has not been studied from the perspective of a proper technical requirements base. Many subsidiary functions are often placed on message switching systems which could not possibly be placed on circuit switching systems. These subsidiary functions contribute heavily to the cost of the switching equipment. Therefore, it is felt that subsidiary functions such as message logging and booking ought to be examined with a view toward their elimination. Also, the requirement to accept messages in a message switching center regardless of the center's backlog ought to be examined. To provide the efficient utilization of transmission facilities inherent of a message switching system, it is necessary only to provide the equipment with sufficient backlog to smooth the flow of messages on the circuits. Beyond that point, messages awaiting delivery could just as well be kept in storage at intermediate switching centers, in local concentrators, or even at the subscriber's premises.

Unless these and other considerations are properly taken into account in the modernization and design of today's and the future military communication systems, we are likely to achieve very high cost, inefficient, and incompatible communication systems. The responsibility lies basically with the military departments. The sophistication required and the art necessary is available in industry today, and the problem is to separate the wheat from the chaff.

THE APPLICATION OF SATELLITES TO GLOBAL COMMUNICATIONS

**SPEAKERS: W. GLOMB AND J. GRANLUND, EXECUTIVE ENGINEERS,
L. POLLACK, ASSOCIATE LABORATORY DIRECTOR, ITT FEDERAL LABS.**

THE HISTORY OF COMMUNICATIONS has been a succession of system expansions using new techniques; which over the years, has followed the world's social and political development. Today, the global communications network is again expanding, but it is limited by the capacity of transoceanic trunks. To communicate across oceans, we are bound to the use of high frequency radio or submarine cables. Both of these transmission media are limited in their traffic capacities. It appears, therefore, that the introduction of the communications satellite is the logical next step in global communications.

The introduction of any new technology, however, must accommodate existing investments and can only grow to its maximum potential as these investments are amortized. In the case of the communication satellite, the initial application will most likely be in supplementing the already overloaded transoceanic communication routes. Once the satellite has assumed its position in the global communications network, its ultimate potential must be explored and exploited. In discussing this ultimate potential we will consider a 24-hour stationary satellite which by virtue of the elements of its orbit remains fixed above a point on the earth. While other orbital configurations may possess unique properties applicable to special problems, we believe that the stationary satellite represents an optimum for global communication applications. It is apparent that this communication system is limited only by the simple geometric fact that from any point far in space only one hemisphere of the earth can be seen. Any two points within this hemisphere, therefore, can communicate directly using the satellite as a relay. The use of the satellite, however, will be bound by rules quite different from those which have resulted in the existing global communication nets. No longer will it be necessary to communicate from Paris to New York by completing the circuit through London, Scotland, and Newfoundland. It will now be possible to communicate directly from one point on the globe to another. The justification for such a circuit will depend entirely on the

traffic available. The principal problem then becomes one of determining the most efficient technique of multiplexing all of the required traffic between the terminals in view of the satellite. The limitations imposed upon this multiplexing are somewhat different from those heretofore considered in terrestrial trunk networks; the requirement is one of most efficiently employing the power capabilities of the satellite. The techniques considered must also be implemented with minimum weight, and most of all, without burdening the equipment with a complexity which will compromise reliability.

Increased Communications Requirements

Before examining some possible approaches to this problem, it is desirable to recall the anticipated growth in communication requirements over the 1965 to 1970 time period in which the satellite will become operational. In particular the spacial distribution of inputs should be observed. Extrapolations of the growth characteristics of the international traffic among industrialized communities indicates that 100 per cent increase will be realized by 1970. Even the most conservative estimates of the future communication requirements of areas, that are only now becoming industrialized, will further double this requirement. It appears, therefore, that a satellite with a minimum capacity of 1000 telephone channels, servicing 50 ground stations, will be necessary to handle the communication requirements of the hemisphere containing North America, South America, Europe, and Africa. The ground stations will be located near major population centers and at other points which have communication requirements but are today isolated in the communication sense. While the example shown is primarily commercial, a similar situation exists for military traffic.

To economically satisfy the traffic requirements of a hemisphere with this minimal capacity satellite, many of the channels must be available to all of the ground terminals on a common user basis. Some channels can also be assigned exclusively to certain of the larger stations which

have sustained minimum traffic requirements. The satellite, therefore, must handle a number of essentially independent inputs, each consisting of one or more channels. The maximum number of inputs, however, would be equal to the number of ground stations.

Since the many inputs originate at widely separated points on the earth, it must be assumed that they are independent and that some technique of identification is required, depending on the modulation method and upon the technique of multiplexing in the satellite. Two general cases have been explored: first, identifying channels on a frequency basis, which is essentially frequency division multiplexing; and second, identifying inputs by their time of arrival or as it is commonly known, time division multiplex. In either case, upon reception in the satellite, the signals must be combined and processed to make efficient use of the available satellite transmitter power. If we consider frequency division multiplex, we have 50 carriers at different frequencies being simultaneously received by the satellite. These carriers are applied to a transmitter which will re-radiate the composite signal to the earth. If no processing other than simple addition is performed in the satellite, the composite signal appearing at the transmitter terminals will have a peak-to-average power ratio of at least 12 db. In radio satellite designs the travelling wave tube is the most attractive from the point of view of weight and efficiency. To realize this efficiency these tubes, however, require input power proportional to peak radio frequency power. If the transmitting tube were to accommodate the composite signal just described it would require a power supply almost twenty times as large and as heavy as that needed for the most efficient system.

Alternatively, we might consider signal identification by time of arrival. If it is assumed that the transmitter at each ground station transmits a pulse at such time as to arrive at the satellite during a predetermined time interval assigned to that station, then a time multiplexing technique can be used. The implementation of this technique, however,

suffers from the uncertainty in the transmission delay from ground station to satellite. This uncertainty may be as much as a millisecond with a noncircular satellite orbit. If a pulse-by-pulse interleaving is attempted, the allowable timing tolerance of such a system for 1000 channels is no more than a few nanoseconds. Therefore, with the assumed orbit ellipticity of 100 miles, the time delay is changing approximately 60 nanoseconds per second. It is apparent, then, that rather precise measurement of the time of transmission is required if such a system is to be feasible. With improvement in orbit control this technique may ultimately prove to be the most efficient.

Any communication technique is justified by its desirability, realizability and feasibility. The first of these is expressed in terms of traffic to be handled, the second is expressed in dollars and in years, while the third is expressed in the jargon of communication theory.

The desirability of a satellite communication system has been established. It is necessary to reduce these concepts to hardware and express their value. The tradeoffs in the

satellite system appear between satellite and ground station cost. For example, if 50 ground stations will be used, each having a service life of 10 years, and it is assumed that satellites will have a useful life of one year, then it appears that a realistic permissible ratio of satellite in orbit cost to ground cost is approximately 5 to 1. Considerable engineering, therefore, can be invested in the satellite design.

A satellite design is essentially limited by energy and reliability. The total radiated RF power of the satellite determines power supply and weight, which in turn establishes the booster requirements. The useful life of the satellite establishes the rate of expenditure of boosters and satellites. While these figures vary considerably, typical replacement costs for satellites are \$1,500,000 per watt. This is for a typical 10 watt repeater, weighing 500 pounds, placed in a stationary orbit by an Atlas Agena B rocket.

Let us consider the way in which we can use these expensive watts. A simple transmission process is available to a global communication system using a relay satellite in a 24-hour equatorial orbit. The satellite

itself will be relatively fixed in its position over a point on the equator and in its orientation with respect to the earth. The fixed orientation allows the use of a satellite antenna with a beam width that just covers the earth. Path loss can be estimated as the ratio of silhouette-area of the earth to aperture area of the ground antenna. It, therefore, is essentially independent of altitude and of frequency over the wide spectrum where both ionosphere and atmosphere are transparent. A realistic estimate of path loss, allowing a few degrees of variation in the orientation of the satellite antenna and a properly pointed 100 foot dish on the ground, is 117 decibels. If the system center frequency is 2 kmc, a 2½ foot dish would be suitable for the satellite.

The round trip transmission lag is about a quarter of a second and can be expected to vary by about a millisecond as a result of the eccentricity of the orbit. However, since the period of the variation in satellite position is a day, the doppler associated is relatively low—about 75 cps at a center frequency of 2 kmc. For paths from separated ground stations, the difference in doppler is only a few cycles per second and can be neglected for voice communication.

Since the satellite antenna views the earth, its noise temperature will be approximately room temperature. It will be reasonable to assume a 9 decibel noise figure for the satellite receiver. The path from satellite to ground is more severely limited by transmitter power capability. Since the ground receiving antenna views the colder background of space, however, the ground system can profitably employ a more sophisticated low-noise receiver. The ground viewing system temperature can be maintained as low as 40 to 60 degrees Kelvin.

Milestones in Satellite Program

The development of a global communication system can best be described by examining some specific milestones in the satellite program. The first step was the passive reflector. This was followed by the store-and-forward Courier system. The next step will be the active repeater or relay which will receive a signal from a ground station and retransmit it essentially at a different frequency.

(Continued on page 58)

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The typical technique used is illustrated in Figure 1.

The weight of the entire satellite will be approximately 175 pounds. This payload can easily be placed in a 22,300 mile circular orbit by an Atlas Agena B rocket. The cost of the satellite will be nominal; the cost of the launching today will approximate \$15,000,000. It is reasonable to assume that this cost will drop substantially as the system becomes operational.

This elementary system will be capable of handling simplex traffic of 1000 channels capacity at 40 db signal-to-noise ratio per channel. Modulation may be digital, either PCM or delta; or moderate deviation FM. The mode of operation will be that of a unidirectional point-to-point trunk.

To achieve duplex operation, the repeater must accept and retransmit two independent carriers. If the two carriers lie within the repeater bandwidth and do not exceed the linear capability of the repeater, they may be received, added without demodulation, and retransmitted. If this is done, however, the peak power will be four times the average power of each. It is apparent that in a peak-power limited device such as a traveling wave tube, the entire system is operating at 3 db lower average power. If as many as 50 ground stations supply separate frequency- or time-modulated carriers to be amplified,—offset in frequency, and retransmitted by the satellite, the distribution of the multichannel signal will be essentially Gaussian. To pre-

vent cross-talk, the peak power capacity of the satellite must be 10 to 15 decibels greater than the average power of the combined signal. The required satellite peak power must then be in the 10 to 30 watt range if the single trunk performance is to be duplicated.

Duplex and multichannel operation, therefore, will require a more sophisticated approach to repeater design. One solution is to supply a separate repeater for each direction in each trunk. It appears that such a system may be feasible in the future with the application of micro-electronic technique.

This approach is actually frequency division multiplex where each channel is assigned a frequency and a guard band to accommodate doppler. This approach exacts a prohibitive price in weight with today's technology. An analogous approach can be developed in the time domain, programming the ground transmissions to arrive at preassigned, non-overlapping time intervals at the satellite. This interleaving must be done at a rate that does not significantly affect the circuit delay. It implies digital transmission with interleaving of pulses or groups of pulses.

For a 1000 channel system, pulse-by-pulse interleaving at the satellite will require timing accuracies of about 5 nanoseconds. An alternate approach namely interleaving of groups or bursts of pulses appears more realistic. In this case, storage for 100 milliseconds, or approximately 5 kilobits, must be provided on the ground in each channel and high speed readout accomplished at a 40 megabit rate. While the technical

problems are appreciable, this approach when implemented requires no complexity in the satellite. The resulting signal can be accommodated in the straight-forward heterodyne repeater.

The application of signal processing in the satellite will modify the basic satellite block diagram as shown in Figure 2. Two schemes are shown. The first accepts a number of independent single sideband channels and phase modulates a local carrier with this intelligence. Since this process must be accomplished at very low phase excursions to minimize cross talk, considerable multiplication must follow to achieve useful carrier frequency excursions. The adders are preceded by elementary gain controlled amplifiers that assure equality of signal powers prior to addition.

A somewhat more rugged type of processing is also shown. Sampled voice in the form of delta modulation is received on a number of channels. Since the elementary intelligence is digital, detection can be readily accomplished. The channel signals are now commutated so that a one-to-one correspondence exists between received channel and transmitted time position. The resulting pulse train can be transmitted directly without further processing.

Both SSB and commutated pulse systems use frequency identification in the ground-to-satellite path. With a stationary satellite and a high capacity system, the doppler ambiguity can be more readily accommodated than the time delay ambiguity. For example, in the case of the SSB to FM conversion at 2000 mc, the differential doppler between channels will be

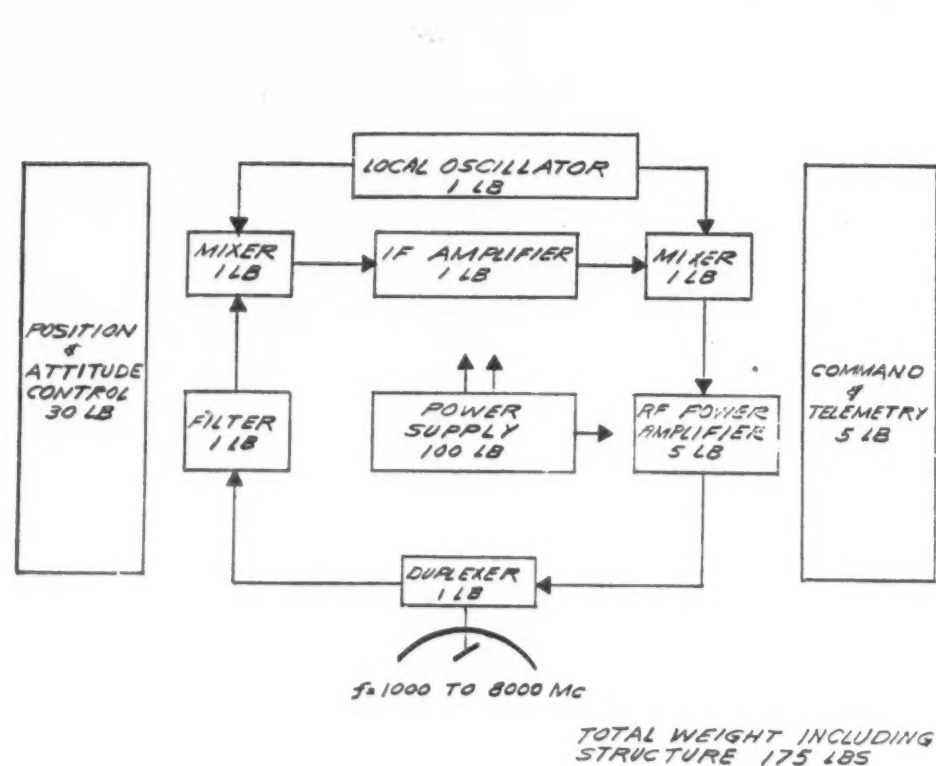
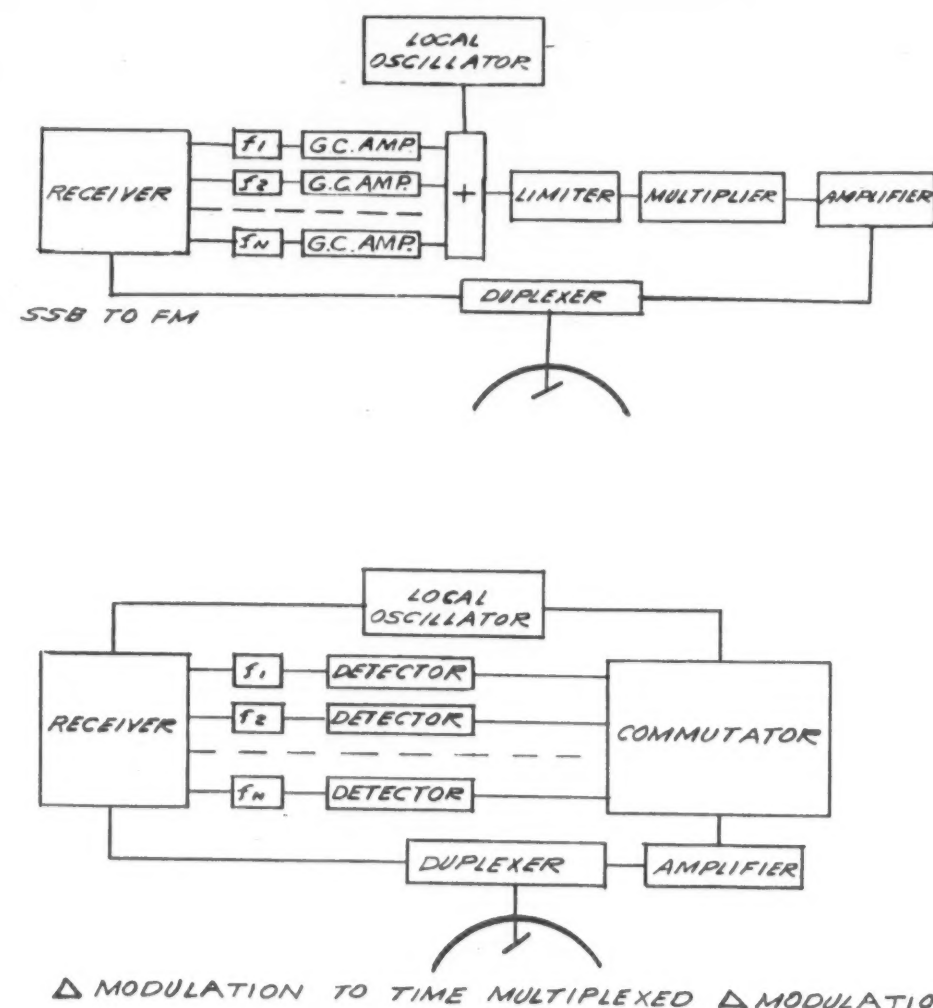


Figure 1 above is a diagram of a Linear Heterodyne Repeater (1000 telephone channels). Figure 2 to the right is a diagram of a Satellite Communication Repeater with processing.



15 cps maximum. Provision of guard bands of this magnitude will increase band occupancy by less than one per cent. The doppler common to all will be 75 cps and can be removed by demodulating the recovered base-band signal against a pilot tone that is transmitted over the satellite system by one ground station.

With the introduction of processing in the satellite, elementary subscriber identification schemes can be introduced and some degree of jamming immunity established.

Jamming immunity can be achieved by increasing the radio-frequency bandwidth of a communication system. The jammer power required to disable a system can be increased by increasing the system bandwidth in proportion; a reasonable hundred-fold increase in required jammer power would mean a hundred-fold increase in bandwidth. Such an increase is clearly out of the question for a 1000 channel trunk system. However, since it is the link from ground to satellite that is most subject to jamming, part of the required jamming protection can be obtained by increasing the ground transmitter power. In a military satellite relay system, where operation at reduced capacity is acceptable under conditions of severe jamming, further protection may be obtained by maintaining the radio-frequency bandwidth ordinarily used to relay 1000 channels, while reducing the number of channels relayed.

A commercial satellite relay system may be difficult to finance unless the potential supporter can be assured that nonsubscribing nations cannot benefit from the use of his investment. Although it is not reasonable to allow non-subscribers to cause a reduction in channel capacity, the necessary assurance can be provided in a number of ways. These include (1) cutting the cost of the satellite relative to the ground station cost and hence relative to the cost to the non-subscriber; (2) using a jam-resistant modulation method that raises the non-subscriber's cost relative to the cost to a bona fide supporter who has "paid his nickel"; and (3) using a satellite that scrambles the signals reaching it, requiring a de-scrambler at the receiver. In the latter operation, the scrambling code would have to be changed from time to time.

The present and future trends of global communication via satellite can be summarized as follows:

Today there are a set of first generation repeaters under development. Characteristic of this group are Advent and Relay. They have the capa-

bility of replacing or creating new trunks between two points on the earth. They are not efficient common user systems, hence line concentration and processing must be done on the ground.

These repeaters will be followed by a second generation group which will possess the capability of handling many independent inputs and retransmitting them efficiently. The ground stations will number in the dozens, and direct access will be available between any pair. Predictions about the ultimate satellite communication system are perhaps dangerous. It is likely that it will be a common user repeater with a capacity of many

thousands of channels. Emphasis will be placed on transmission techniques which will permit access to the system by smaller and more economical ground stations. In the commercial environment, this will allow every major population center direct access to the global network. In the military, the direct communication to small mobile stations is inevitable.

The satellite communication systems possess a range and flexibility unique in the communication art. Though its initial application will be related to ground networks, its ultimate use must develop independently of these restrictions.

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The advertisement features four circular illustrations arranged in a 2x2 grid. The top-left illustration shows two figures in a control room with the label "SECURITY". The top-right illustration shows a rocket launch with the label "OBSERVATION". The bottom-left illustration shows a large satellite dish with the label "ANTENNA ALIGNMENT". The bottom-right illustration shows a control room with multiple video screens and the label "DATA TRANSFER".

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COMMUNICATION SYSTEM TRENDS

R. L. SAN SOUCIE, MANAGER, ADVANCED COMMUNICATIONS SYSTEMS LAB., SYLVANIA ELECTRONIC SYSTEMS

THERE IS AN ACCELERATED emphasis on communication systems operating in different portions of the radio frequency spectrum, and on exotic systems operating in conventional bands. Such activity is made necessary by the tremendous volume of communications now occurring, by the exponential growth foreseen in this field before the end of the decade, and by certain special requirements of particular communication systems customers, including the need for reliable, round-the-clock voice and teletype circuits. For the most part, the systems to be discussed are pointed toward military applications. We who are in the business of commercial data handling and transfer, however, hope for and envision many commercial possibilities in these same fields.

The mention of very low frequencies will doubtless bring to your mind Navy transmission facilities. In particular, you may recall recent information releases on the new Cutler, Maine, VLF station, with its two megawatt transmitter and its twenty-six antenna towers, two of which are only four feet shorter than the Eiffel Tower. Occupying 2850 acres, Cutler, and other similar stations, provide the principal means by which the Chief of Naval Operations communicates with the fleet at sea.

LOFTI I

It is natural enough, therefore, that the Navy should be attempting to lessen its dependence upon these large, fixed stations. One highly significant activity pointed in this direction has been carried on, with little publicity, by the Naval Research Laboratory. It is known as the LOFTI experiment, with LOFTI an

acronym for Low Frequency Trans-Ionospheric (experiment). NRL's earth satellite LOFTI I was designed for exploratory measurement of 18 kc/s signal levels in the earth's ionosphere. LOFTI was launched on February 21, 1961—jointly with the Transit navigation satellite. In accordance with Murphy's law ("That which can fail, will!"), the second stage of the launching rocket failed to separate and the assembly assumed an unintended, highly elongated orbit, with apogee about 600 and perigee about 100 statute miles. However, such an eccentric orbit enabled the satellite to repeatedly traverse much of the ionosphere in depth over a terrestrial area extending from about 28° N to 28° S latitude. VLF signals at the satellite were received, translated and transmitted to ground stations in North and South America via 136 mc/s telemetry.

Much data has been recorded from this experiment, and analysis thereof continues. Nevertheless, I would like to mention a few tentative conclusions of significance to the system designer. First of all, the 18 kc/s precise time and constant frequency transmission of the 30 kw Naval Radio Station at Panama were received at all times and at all heights. On several occasions, the signal levels exceeded the 10,000 microvolts per meter saturation level of the receiver. Secondly, marked diurnal effects are apparent in the data. It appears that relatively little 18 kc/s signal energy is dissipated in the night-time ionosphere and that, as expected, trans-ionospheric attenuation in the sunlit region is much greater. Thirdly, the observed delay in time of VLF signal arrival at the satellite, derived by

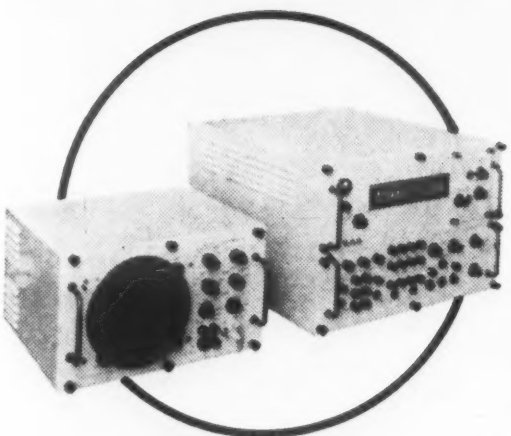
comparison with the same signals as received by ground VLF receivers, indicates that the average velocity of the VLF wave in the ionosphere is much less than the speed of light in free space. Finally, strong echoes of NBA's timepulses were observed in the data. The echo delay time is as much as two-thirds of a second, indicating magneto-ionic mode propagation of the VLF signal energy similar to that postulated in the case of whistlers.

NRL informs me that further LOFTI experiments are planned, instrumented for exploration of the ionosphere at higher latitudes and over a broader band of ULF and VLF frequencies. One of the experiments will explore the reciprocity of trans-ionospheric propagation by means of a VLF transmitter satellite and thus pave the way for the significant system application: use of such satellites for transmission to fleet ships and submarines. It seems quite likely, also, that this relatively novel communication satellite can be used to provide navigational aids for deep space exploration—a system requirement not many years away. It should be noted here that operational VLF satellites will be providing a vital link in our deterrent capability: communications to Polaris-carrying nuclear submarines.

Another strategic weapon in our deterrent force is the Minuteman missile. And associated with this missile is another example of a reliable but unconventional communication system—a buried antenna radio launch control system being developed by General Telephone and Electronics Corporation, under contract from the Boeing Company.



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Underground Radio Systems

Actually, the trend to underground radio systems has been underway for some time—partly as a means of providing reliable "survival" communications in case of enemy nuclear attack, and partly as a means of relieving the overcrowded spectrum previously mentioned. Many companies are involved in these developments, and the system literature is already quite extensive. I shall attempt to highlight only two general types of such systems, and will begin with the so-called "deep current" variety.

The earth's crust usually consists of some type of soil underlain by wet or dry sedimentary rock. A dry layer of sedimentary rock bounded by wet conductive layers has been found to act as a natural waveguide, useful for transmission of radio frequency energy. These so-called sedimentary type waveguides, in most places under the earth, are underlain by deep crystalline (granite and basaltic) rock waveguides called basement-complex guides. Deep current systems are being developed using both types of waveguides.

G. J. Harmon of the Raytheon Company has recently detected 200 kc/s signals at distances up to eighteen miles using the basement complex

and radiated power of about 100 watts. He predicts ranges of 50-100 miles for frequencies between 15 and 40 kc/s in the near future. The Developmental Engineering Corporation, in experiments conducted at abandoned mines in New Mexico, transmitted radio teletype signals at 1,000 foot depth for 4½ miles using less than 200 watts of power. They recently reported ranges of slightly more than 100 miles.

It is worth emphasizing that such deep current systems, operating in waveguides insulated from the earth's surface by several conductive layers, are quite invulnerable to jamming, man-made noise, and atmospheric disturbances. Full noise studies, however, are not yet complete.

In contrast to the deep current systems mentioned above, the radio launch control system for Minuteman is an example of the shallow-current variety. In such a system, radio waves from an underground transmitter are radiated by a gridlike antenna buried a few feet below ground. These waves travel upward to the earth's surface, disturbing the earth-atmosphere interface, and travel along the channel formed by the earth as a conductive medium and the atmosphere as a non-conductive medium. They then travel downward to the receiving antenna. Space Electronics Corporation, under a contract from Boeing, proved the feasibility of such a system in 1959. Boeing is studying how various types of soils and their moisture content affect signal transmission, and how underground location determines antenna shape and power requirements. Spread spectrum transmitting and receiving equipment, for communicating launch messages between the launch control facility and the buried Minuteman silo, as well as operational messages between launch facilities, is being developed by General Telephone and Electronics in Buffalo, New York.

Earth current systems then are feasible and practical. Much more work has been done than I can summarize—a good deal of the work is classified and most interesting. I think it fair to claim that "survival" systems will be very much in evidence in the next decade.

In describing a few significant developments leading to extensions of the usable frequency spectrum, I have neglected discussion of satellite communications as such. The topic has become so popular that even our ten-year-olds have become conversant with the art. Sufficient it is for me to remark that after a few more years some enterprising company could

make a fortune selling space vacuum cleaners to people trying unsuccessfully to use their allocated space frequencies. I am afraid that space will become rather cluttered with "separated" rubbish.

Any discussion of system trends leading to reliable communications in the next decade would be quite incomplete without comment on the revolutionary developments which have recently been occurring in heretofore largely unused portions of the frequency spectrum—the millimeter and optical bands.

Millimeter Systems

Within the past few years the millimeter region has received considerable attention, largely because of certain unique features which make the use of millimeter waves for both space and earth communications a certainty. In particular, rapid variation of atmospheric attenuation with frequency, in these bands, can be utilized by the system designer to provide precise communication range control. Atmospheric absorption can also be employed to prevent mutual interference and allow simultaneous use of identical frequencies for proximate applications.

The use of millimeter systems in space is also desirable because of the small physical size of the components. High antenna gains and small beamwidths are possible with small physical apertures. Large bandwidths are likewise available to support high data rates. Moreover, continued improvement in solid state devices indicates that harmonic generation will soon provide power at millimeter wavelengths—thus resulting in small signal sources for space system use.

At our laboratories in Buffalo we have constructed a millimeter link in the 60-70 kmc/s range in order to evaluate components, establish system parameters and record propagation data. We are operating a line of sight link with a range of 3.3 nautical miles, utilizing a klystron, pulse position modulation, time division multiplexing to provide two-voice-channel operation, effective receiver bandwidth of 2.8 mc/s and a 12 inch parabolic dish having a theoretical gain of 47 db at 70 kmc/s. These parameters, and others, provided us with the required 53 dbw effective radiated power. The experiment has proved highly successful and we expect to utilize the information thus obtained in system designs for this frequency band.

Higher antenna gains and increased directivity for a fixed aperture, smaller and lighter components, and
(Continued on page 64)

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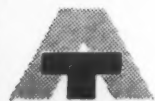
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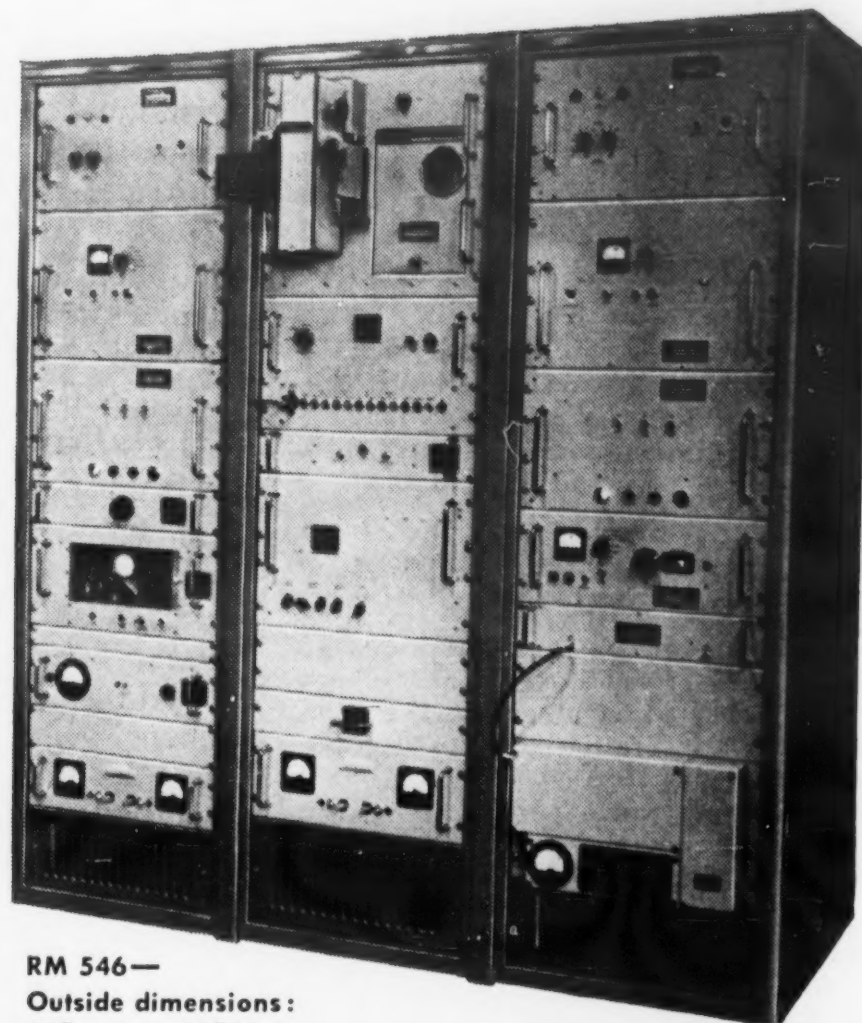
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PRINCIPLES OF ELECTRONIC WARFARE

BY ROBERT J. SCHLESINGER

Collaborators:
MARK ABBEY, RICHARD W. EHRHORN, KENNETH
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As large-scale weapon systems are depending increasingly on electronic technology it is vital the *principles* (involving both engineering sciences and military strategy) be broadly understood.

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In electronic warfare "radiation and detection" are considered like "offense and defense" in strategic and tactical warfare. The overall treatment here presented (engineering aspects plus operational factors) are of direct interest to professional engineers and everybody concerned with deployment and tactics.

Chapter 1 points up representative situations in electronic warfare.

Chapter 2 relates the broad concepts of techniques and tactics, discusses classic ECM methods.

Chapter 3 introduces mathematics of probability and applies this to noise theory, inherent to many parts of the problem.

Chapter 4 covers electronic intelligence and problems of reconnaissance systems, including the relationship between reconnaissance inputs and ECM tactics.

Chapter 5 presents a basic analysis of radar systems with stress on parameters important to ECM and ECCM techniques.

Chapter 6 deals with antennas as the transducer between the electronic system and the environment, and identifies critical factors of the electronic warfare system.

Chapter 7 provides an operations analysis approach for establishing an effective ECM environment on a mission profile, with typical constraints.

Chapter 8 projects thinking into the space era, studies ramifications of electronic warfare as a result of space flight.

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greater information bandwidths are inherent to even higher transmission frequencies; e.g., the submillimeter region. Of the several approaches to the generation of submillimeter waves, techniques utilizing the bulk effect properties of semiconductors and the Tornadotron show promise for pulsed signal sources. These techniques may hold the key to a closure of the gap between the millimeter and the recently explored optical regions.

Optical Systems Problems

Optical systems have been under study for some time but three basic problems have limited their consideration as substitutes for radio systems. These limitations are atmospheric absorption, background noise intensities and scattering due to atmospheric impurities. It is relatively clear that these conditions do not limit system applications in deep space. Still to be solved, however, are the problems of providing good signal sources, and satisfactory modulation and detection methods. Rapid strides are being made in each of these areas, and I shall attempt to highlight the most significant trends.

The problem of signal sources for optical systems has been one of generating and amplifying coherent light. Most readers are aware that microwave frequency energy has been generated by vacuum tubes and solid state devices. The maser, invented by Professor Townes in 1955, proved to be a remarkable addition to these sources of energy. Further developments by Professor Townes and Dr. Schawlow led to maser modifications producing energy in the infrared spectrum region. The most revolutionary development was accomplished by Dr. T. H. Maiman of Hughes Aircraft, who developed the laser—an acronym for *light amplification by stimulated emission of radiation*. The laser generates and amplifies coherent energy in the optical band and, for this reason, is often called an optical maser. The numbers involved are staggering, even to those of us conversant with the microwave art. In particular, lasers generate coherent energy in the optical spectral region at 500 trillion cycles per second. Independent of Dr. Maiman's discoveries, many improvements have been made in the maser—one of the most recent, for example, being a continuous output optical maser, or laser. The principal significance of the latter result is that the coherent infrared radiation so generated has a bandwidth narrower by 10^5 than that obtainable by more conventional masers. Such a prop-

erty has made possible the heterodyning of optical signals for the first time. Indeed, voice modulation of coherent optical beams has recently been proved feasible by scientists of the Bell Telephone Laboratories.

What are typical system parameters? Here is one possible set: using a 10 cm optical maser transmitter and a 1 meter diameter receiver aperture, approximately 100 watts of absolute power would be required to support an information rate of about 10^5 bits/second from Mars to the earth.

Recent experiments have proved the feasibility of transmitting maser-generated light pulses along 1500 feet of 2 inch diameter circular waveguide, so that atmospheric impurities do not attenuate the light beam. Multiplier tubes at the end of the waveguide recorded clear pulses of high intensity light. Here again, experimental results might be listed for many hours. I believe you can see, from the examples given, that we are facing an entirely new technology and that practical systems can be operational in the next decade.

In another direction, the Air Force has recently sponsored desert field tests of an experimental communication system using sunlight as an information carrier. These tests were conducted in the Mojave Desert by Electronic Optical Systems, Incorporated. The tests were designed to see if prototype equipment was operating satisfactorily and to prove that optical systems might be used for deep space applications. Preliminary results showed that information can be transmitted at least two to three million miles using a transmission rate of about 10 bits/second at maximum range. Using specially designed attenuators to simulate large distances, non-modulated light signals were received over 10 million simulated miles. With a bandwidth of 20 cps, a signal-to-noise ratio of 16 db was obtained for simulated transmission distance of approximately 1 million miles. Modulation and detection techniques must again be refined but workable schemes are already under development.

In conclusion, I would emphasize that the types of systems we have been reviewing are not ivory-towered paper designs that won't work. In each case I have selected technological developments that have already passed the stage of feasibility demonstration. For this reason I can truthfully say to you that these are the trends for our next ten years of communication system design.

EQUIPMENT TRENDS FOR RELIABLE COMMUNICATIONS

SPEAKER: A. F. CULBERTSON, DIRECTOR OF ENGINEERING, LENKURT ELECTRIC CO., INC.

IN THE ATLANTIC MISSILE RANGE a data transmission system has been in service for over one year. This system includes a total complement of over 2000 transistors and 4000 diodes. During this period there have been only three component failures—two of which were semiconductors: one transistor and one diode.

Yes, it is certainly true that transistorized equipment can be designed to be ultra-reliable, but it is not necessarily true that just because equipment is transistorized it will fall into the high reliability category. A number of other considerations are important, and some of these considerations are the things I propose to discuss.

Component Manufacturing

The producer of reliable equipment learns very early in the game that it is necessary to control the manufacture of his own critical components. The demands of a commercial components market and the demands of high reliability equipment often are not compatible. Therefore, when the choice is faced to go into component production, it is difficult to envision it as a profit-making product line as well as a source of supply. As soon as you undertake to go into competition with your former vendors, you will find the same problems besetting your component assembly lines that beset them, and the quality of your components dropping to the point which caused you to reject theirs.

For example, let us consider a typical clean room facility in a modern electronics factory. However, this clean room is not established for the purpose of manufacturing gyro components or electron tubes. This facility is used for an ordinary capacitor winding operation. For long life and reliability in capacitors, it was found necessary to control very sharply the humidity and dust content in the atmosphere surrounding the winding operation.

A very difficult thing for the commercial component supplier is to have the fortitude to hold his product in the aging process until it is absolutely ready to be installed in a piece of high reliability electronic equipment. Too often the competition comes along with a surplus inventory, or more glowing promises and the business is lost. In the field

of quartz crystals, it is important to know everything there is to know about each individual component before it is placed into a highly reliable oscillator or filter circuit. Therefore, it is good practice to run an extended aging process of 100 percent of the crystals used. The fallout from this process and other quality control steps taken on crystals from the manufacturing operation is great enough to make the entire production line uneconomic and non-competitive, but is absolutely essential to maintain the reliability standards.

The lowly transformer would seem to be a device with which very little can go wrong, and yet we know from experience that there is a great difference between a competitive transformer and a high-reliability transformer. It is hard to produce a competitive product when 100 percent inspection is practiced at three different points during the production of even a relatively straight forward component. It is particularly difficult when the girls doing the inspecting report back to the chief engineer rather than to the manufacturing vice president, and when they have the power to shut down the line at any point where quality seems to be deteriorating.

Reliability in an electronic circuit quite often comes back to accuracy in the laboratory. We all know that the accuracy in the lab must be at least an order of magnitude greater than that which we demand from the finished product out of the factory. This is particularly true when measurements of difference on the order of 90 db are involved in the production operation. This accuracy can only come from a high-priced and carefully maintained set of electrical standards. While no production meters ever pollute the controlled atmosphere of this laboratory, secondary standards from key calibration points in the development laboratories and in the factory are carefully checked here on a periodic basis. In addition, standard frequencies are piped directly from this laboratory to all points where engineering or production frequency measurements must be made.

In some industries the loving skill of the experienced craftsman when lavished on each unit of the product is the best guarantee of quality. In

the electronics industry, we know that even the most skilled craftsmen have their bad days and even the most experienced operators can occasionally do a poorer-than-normal job. This is where automation of production operations can provide us with a higher degree of reliability in the end product. While it is true that the most carefully designed machinery can still make mistakes, it has the advantage that it does not make them on just a few pieces at a time. Failures in the automated machinery tend to be catastrophic so that while we may be faced with the loss of an entire batch of units, at least we can clearly identify them so they do not get into the end product.

Reliability Through Circuit Design

Much work has been done in redundant circuitry, in automatic fallback, in alarm and control, and in adaptive circuitry. But there is still a key matter of judgment to be applied when it is recognized that the efforts required to get the advantage of redundancy must not complicate the circuit to the point where the fallback mechanism is the most vulnerable point of this part of the system.

This approach has the advantage that there is no active circuitry involved in the fallback whatsoever. Loss of one of the two amplifiers merely causes a phase shift without change in amplitude. The only extra active gadgetry needed is the alarm circuit which then goes to work and notifies the attendant that his protection has been lost, although service has not been interrupted.

Maintainability

In spite of our best efforts, failures do occur and service will be interrupted. If the equipment has already been blasted off or is in orbit, the cause is already lost and maintainability drops out as an item of importance. But the fact is that an overwhelmingly high percentage of our equipment is used in locations where under some circumstances or other, it is accessible to human beings for repair. In the design of equipment intended for this type of use, maintainability for rapid restoration of service is a factor which must not be overlooked.

The term "human engineering" has probably been badly overworked in this connection, but human engineering is probably the label which most aptly fits the work that has been going on for a long time in molding the design of high reliability equipment to fast service restoration.

It comes as a shock to many that the most significant factor in the cost of high reliability equipment is quite often not the use of exotic components or precision techniques which push the state of the art, but rather the many extra features provided to run in-service tests and make rapid restoration in the case of failure. In this category come elaborate jackfields, alarm circuits, wired-in metering features, and plug-in subassemblies.

The skill of technicians available at repair centers can also sometimes be a variable factor. In the civilian

telephone industry, where investment in the inventory of spare parts is a matter of special concern, additional emphasis needs to be placed on reparability of the individual units.

It is generally accepted that the change-over to solid state has achieved a drastic reduction in heat dissipation.

The careless designer may still find that solid state components have not solved all the heat problems. Power-dissipating resistors and power transistors can still cause considerable grief, if they happen to be placed at the wrong point in the equipment. There is need for close collaboration between the mechanical engineer and the electronic engineer at the conception stage and at every step of the circuit design if the objective of high reliability is to be achieved.

Conclusions

It might be assumed that elimination of tubes in electronic equipment has solved most of the reliability problems. But we know from experience in the design of telecommunications equipment that this is not the whole story. The story begins with careful control of component production and proceeds through careful circuit design. Redundancy, where provided, must be done without excessive complexity. Finally, we must face the fact that a high percentage of our equipment is located where it can and must be maintained. In spite of our best efforts, there will be failures requiring human intervention. Troubles must be diagnosed quickly and service restored promptly. Good equipment design will pay off here as in all other areas achieving long life, trouble-free, reliable communications.

CONSTANT QUALITY COMMUNICATIONS BY ADAPTATION

SPEAKER: S. STEIN, SENIOR SCIENTIST, APPLIED RESEARCH LAB., SYLVANIA ELECTRONIC SYSTEMS

A LARGE NUMBER of communications applications involve fading radio channels or channels subject to time varying interference. In such applications, the user is often extremely interested in being able to always maintain at least a minimum communications capability, with a signal of useful quality. The user will be willing to forego his normally available information transmission rate under poor signal conditions in return for the availability of such a minimum signaling capacity. Typically, in a digital communications link, the minimum useful quality is given in terms of a tolerable error rate, which may vary from one error per 2,000 characters in some applications, to perhaps one bit error in 100,000 or per million for encrypted digital data.

In present designs, a minimum signaling capability may be achieved in two ways. One is for an operator to recognize that the channel has deteriorated and to change the operating mode, presuming that such a change in operating mode is available. A simple example of this is the slowing down of speed in hand-keyed Morse in the presence of severe noise or interference. In a high speed circuit, the available automatic modes are likely to involve only very discrete rates; moreover, one would presum-

ably have a more effective operation if any such changes could be made automatically in a reliable manner.

The other alternative is simply to design a system with enough system margin available so that the minimum quality requirement is met under the worst expected channel condition. This is the typical technique used in designing, for example, tropospheric scatter systems where the design quite often is based on the very poor channel conditions encountered, for example, only during 0.1% of the time. Military applications which involve anti-jamming techniques are similarly likely to include enough margin so that the system will operate with the minimum tolerable quality under the worst expected conditions. In such systems, due to the very large margin, there is no change in data rate at the minimum operating point. However, by the same token, this huge system margin is not needed most of the time, and over this large fraction of time the error rate will be very much less than that which can be tolerated, simply because the signal-to-noise ratio is so much better than the design condition. In a very large sense, such an operation involves a very significant waste of average channel capacity. The greater the range of variations, the greater the waste. Economics dic-

tate that one should try to make better use of the available system margin by sending at higher data rates when the channel allows them.

What one would like instead, therefore, are techniques which automatically maintain the required signal quality at all times, but employ the channel at every instant at the highest information rate allowed by condition on the channel at that time. The net result will then be a high average rate of information flow which, in effect, uses the channel to greatest effect at all times. It will be my purpose to indicate some of the recent trends in research in this area, not in the context of any single application, but rather as a generic communication technique applicable to a wide variety of communications problems.

Systems which automatically change their operating format by using circuits which somehow sense the conditions on the channel, have come recently to be called adapting (or adaptable, or adaptive) circuits. I will not discuss the entire class of such systems. In particular, one class which I will not discuss is that of so-called adaptable receivers, for example, the Rake-type of system which may be familiar to some of you, or even ramifications of the time-varying receiving system techniques categorized as diversity operation. Rather,

I want today to discuss only that class of adapting systems which have come to be termed feedback communication systems.

Feedback Communication Systems

Feedback communications is in part a new name for a very old and useful concept. For example, I feel certain that everyone here is aware of the growing use of algebraic coding techniques for error control in the digital systems. Such coding techniques take two forms. One is the use of so-called error-correcting codes—systems where in the decoding process, errors at the receiver detection circuits can be *corrected* through redundancy built into the transmitted signals. But an equally important class of codes is that known as the *error-detecting* codes. This is a simpler class of codes in the sense that less redundancy is needed to only detect that an error has occurred without correcting it. However, in communications, knowing that we have received a message erroneously is only half the battle. What we really need is the correct message, and the only way now to get that message correctly is somehow to signal to the transmitter that it has to be sent again. This request for repeat involves in the fullest sense of the word the use of a feedback circuit. Indeed, in a short-time sense, the system is adapting to the channel, in this case to the noise burst at the receiver input which caused the errors; and in a long-term sense, there is an adaptation in terms of average message transmission rate as a function of average channel signal-to-noise ratio, because of the use of the channel for repeats of messages. What I have described, of course, is a generalization of the Van Duuren, ARQ system such as employed on high frequency radioteletype circuits.

There have been several investigations and developments reported in recent years both in adapting the simple ARQ principle to other problems, and more importantly, in generalizing it. The generalizations have taken the form of examining the possible use of long code blocks and/or other than algebraic coding techniques for determining the existence of errors. An example of the latter is the use of so-called null-zone detection in which the receiver simply refuses to process any signals received at an instant when the signal-to-noise ratio is too low, because of the high likelihood of an error. Unfortunately, in most of the more general analyses made to date, a rela-

tively clean return channel has been assumed, i.e., one unaffected by either noise or fading. One factor hindering more extensive application of sophisticated feedback techniques to rapidly fading systems has been a lack of detailed understanding of how well they will perform in an actual environment where noise and fading can cause errors on the feedback circuit.

A good deal of current research is directed at answering this specific question. It has already been pointed out in the literature that the question is not only average channel performance, i.e., the trade-off in terms of system margin, but also in the fact that errors in the feedback loop can cause a problem very peculiar to feedback systems, a problem which we have termed "message displacement" and others have termed "transpositions." In effect, what can happen is that the receiver can request a message repeat, but the transmitter by not recognizing this request can simply go on spewing out new information, and the portion which was supposed to be repeated will be lost. Alternatively, the transmitter can think that it has received a repeat request when in fact no such request

was initiated, so part of the message will be repeated over again but will be interpreted as additional message data by the receiver. While loss of a character in clear language text is not disastrous, the message displacement problem does appear to be especially formidable in computer data transmission, and in military applications employing encryption techniques. In terms of over-all system design, a partial solution appears to be for the signal transmissions to always include a positive indication of what the transmitter is doing, i.e., sending new data or repeat data according to how it has interpreted the feedback control signals. However, much research remains to be done before we can regard our understanding of such systems as satisfactory from a practical application viewpoint.

This last discussion points up a very major problem encountered by all repeat request systems. I have just mentioned that one problem, message displacement, can perhaps be cured in large part by insisting on including control information within the transmitted signals. The price we pay is part of our channel capacity, and it is clear that this becomes

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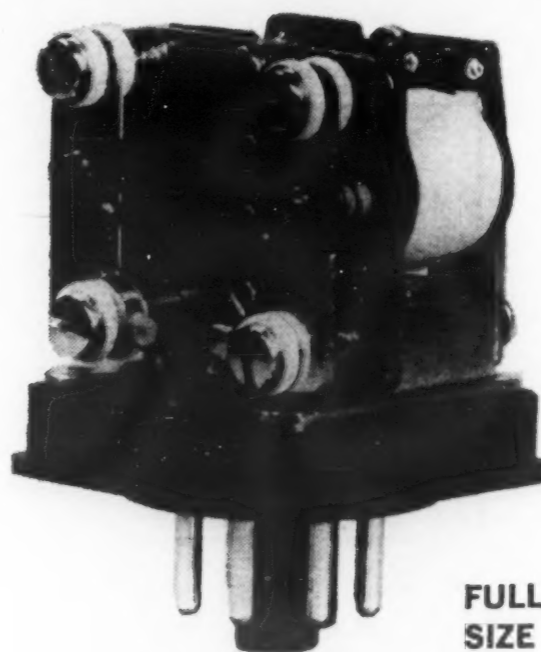
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rapidly unprofitable if such control signals have to be sent too often. This may become a significant part of the larger price we pay in using a repeat-request system, in the channel capacity taken up by the message repetitions themselves. In fact, further thought suggests that in any simple repeat request system there is some "threshold" signal-to-noise ratio below which this system will become completely tied up just processing repeats and requests for repeats, because the quality of the signal at the receiver is too poor. In view of the added information which has to be processed as part of the repeat requests and repeats, the actual message rate can be expected to decrease extremely rapidly with decreasing signal-to-noise ratio as the number of repeat requests per message unit becomes exorbitant below this threshold.

Sequential Decisions

There is more than one possible solution to this problem. One solution which has been suggested involves in effect the use of so-called sequential decisions, in which one examines the totality of transmissions related to a particular piece of message in making the decision as to whether an acceptable determination is available, or whether further repeats are necessary. However, this type of system does not appear to avoid the problem of the additional identification information, which it appears necessary to transmit in any repeat request system. A more attractive solution appears to lie in utilizing feedback not only to correct errors detected at the receiver, but more importantly, to modify signaling at the transmitter. At high frequency, for example, the operator shifts to one of his other frequencies. Assuming that in most applications, such a simple remedy is not available, the only essential parameter which can be varied to maintain the quality of the received signals is the data transmission rate. With the signal quality preserved, then for example, any associated coding techniques will always perform well because they will be performing at their design point. As an illustration, in a matched filter receiver, if the error rate rises or the path attenuation increases, one can conceive of slowing the bit rate so that the ratio of received energy per transmitted bit to noise power density at the receiver remains at some fixed level. At this lower transmitted data rate, the bit error rate will, however, now be the same as it was before the change in the channel occurred. With

such a system, the data rate will vary in a strict inverse proportionality to the signal-to-noise ratio, and at every level of signal-to-noise ratio, the quality of signal will remain the same. No longer does there appear any sharp threshold in the rate at which information decreases as a function of signal-to-noise ratio. The gradual inverse proportionality, "graceful degradation" as it has been sometimes called, is in many ways one of the major goals of reliable design in communications for command and control systems, as well as many other applications. In distinction to the repeat request type of feedback communications system, we term this second type "average improvement."

In a sense, average improvement is the same principle which is used on meteor burst communication channels, i.e., signaling only when the channel attenuation is low and not signaling when the attenuation is too great. What we are emphasizing is the extension of this concept to fading channels which do not simply change between two extremes as in the meteor burst case. However, it should be added that even going to on-off operation, as in the meteor burst system, has been shown to be very useful in more general channel fading situations, for the major reason that one then avoids attempting to signal at the extremely low signal-to-noise ratios at which many errors would occur, and so the over-all error rate can be kept quite low.

Future Use of Feedback Techniques

It is our firm belief, based on our current research observations, that the real future utility of feedback lies in the proper combination of repeat request and average improvement techniques. I have already pointed out that such a combination will provide a fixed transmission quality with only a gradual change in data transmission rates as a function of variation in channel parameters; at the same time, within this fixed quality we can efficiently operate with error correction techniques using either error correction coding, or error detection repeat request techniques, to compensate for those bit errors which still occur due to receiver thermal noise. There is, moreover, another significant reason for combining the techniques. It is apparent that average improvement can only be applied where channel variations occur slowly enough so that the channel does not change over time periods comparable to the over-all round-trip path delay, since other-

wise, information about the channel cannot be obtained back at the transmitter quickly enough to be useful. When fading is more rapid than this, one can only hope to operate on the average level of the fading, with the

use of repeat requests or other error detection and correction techniques to compensate for those errors which still occur.

In general, the feedback communication techniques in combination with

other combination techniques in the research and development stage seem to hold much promise for obtaining reliable communication on the rapidly expanding and extensive networks being planned.

INPUT-OUTPUT CONSIDERATIONS IN RELIABLE COMMUNICATIONS

SPEAKER: A. L. SOLOMON, MANAGER, CHEMISTRY LAB., GT&E LABS., INC.

IN THE BROADEST SENSE, input-output considerations in communications imply man-machine relationships. Man employs the machine as an extension of his voice over long distances by telephone or his pen by teletype. Whatever the nature of this extension, the function of reliably transferring information between man and machine must be satisfied.

At this point in communications history, an important man-machine problem is that of visual display. We have yet to master methods of reducing a large and complex amount of data output from a machine receiving information from many remote locations into an easily read, quickly written and updated display. We have yet to realize person-to-person communications that involve both sight and sound in the form of compact, rugged equipment.

I want to tell you of a means that will answer these needs, electroluminescent displays and related devices. These devices serve as terminal

equipment and the principles and techniques involved in obtaining these displays have resulted in new techniques of data processing.

First let us consider the basic device. Electroluminescence is a process whereby light is generated in solids by the application of an electric field. The importance of this device is that this phenomenal result is obtained in a relatively easy-to-prepare, readily employable structure. The electroluminescent lamp has three layers of materials covering the lamp's metal base. Directly over the metal base is a ceramic ground coat, which is covered by a ceramic dielectric with electroluminescent phosphor. A transparent conducting film forms the outer layer. Essentially light is produced in a glass embedded phosphor layer by applying an AC field to two planar electrodes. One electrode is transparent to transmit light. The other electrode is formed essentially by the metal substrate. With proper mounting, the light source has oper-

ated through rain, sleet, hail and such missiles as stones and bullets. The brightness rises nonlinearly with increasing voltage and almost linearly with frequency in the range shown. For 60-cycle operation, these lamps undergo an extremely slow decay, with half the initial brightness after twenty thousand hours of operation.

A variety of dynamic display devices are obtained on a flat panel when many electroluminescent elements are produced by patterning one or both electrodes of a large lamp. Digital displays in a large range of sizes have been made. A complete message system, which could be used in aircraft, may be constructed by employing a number of these characters side-by-side on a thin panel.

When we think about a message system, we are also thinking about a switching control network. A compatible switching network is a panel switching matrix composed of electroluminescent and photoconductive elements. Photoconductors, layers which conduct when illuminated with electroluminescent elements, make up direct switches, inversion switches and storage circuits. Let us consider a panel containing 49 switches which are used to translate from a decimal input to the code that describes the combinations of segments to obtain the desired numeric display. This 49-switch matrix is the size of the numeric panel display. It is composed entirely of inexpensive polycrystalline materials. Switching matrices have also been made to translate from a binary code to a decimal as well as the converse. Others translate from binary code directly to the electroluminescent display code. Small photoconductive electroluminescent panels may be used to effect all the necessary distribution and holding functions to control electronically a large group of characters. (See Figure 1)

With this capability in hand, we can now construct a variety of message systems. Let us consider an

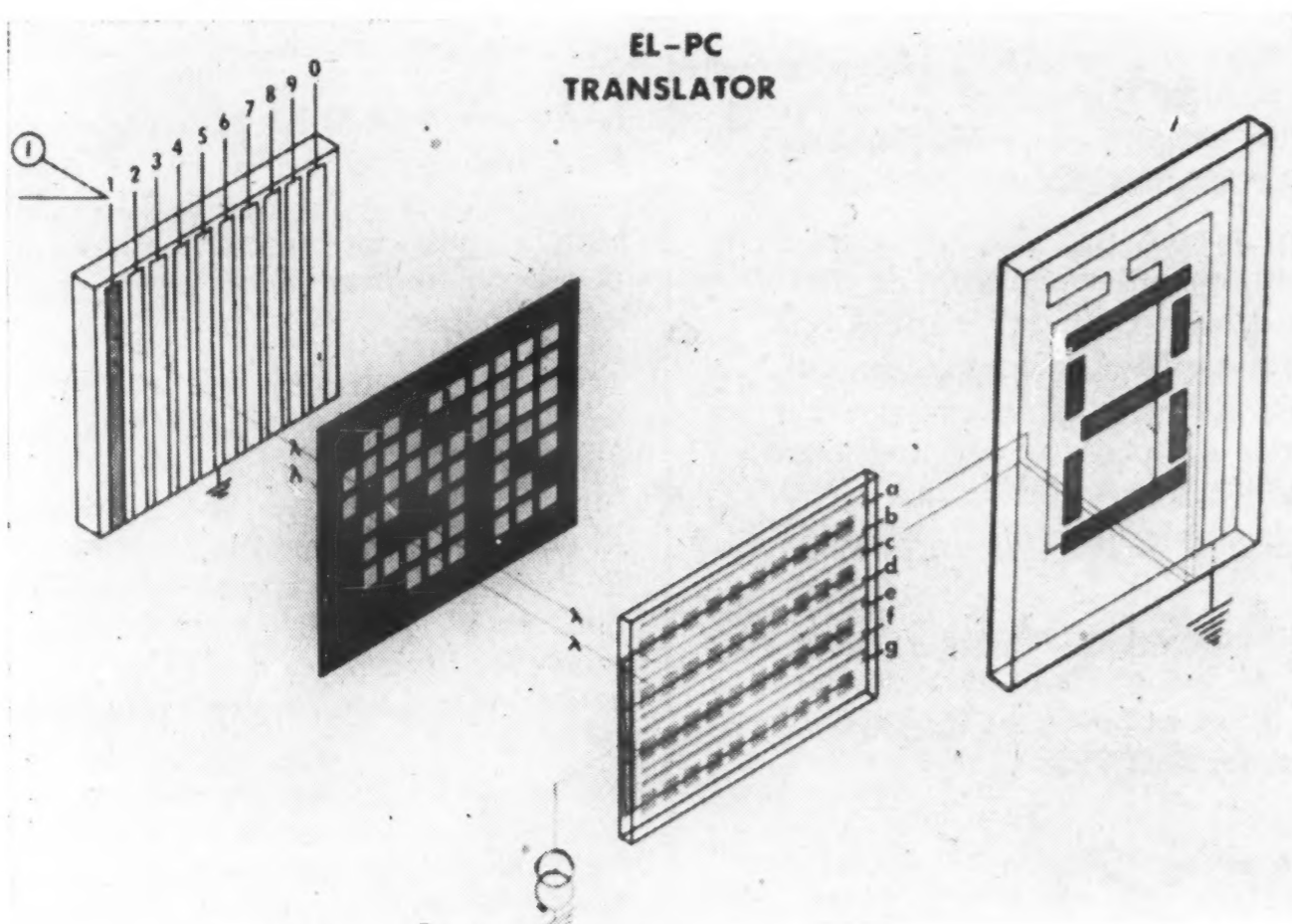
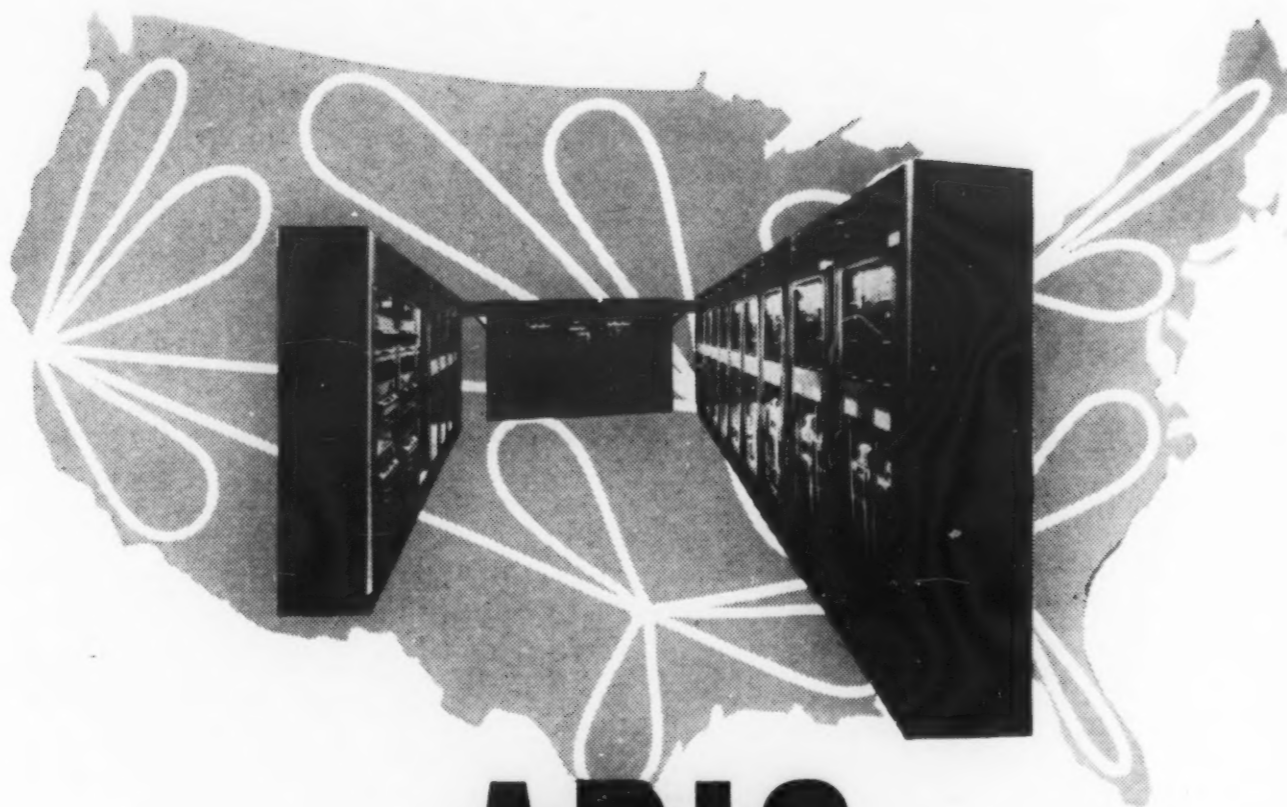


Figure 1. Electroluminescent-Photoconductive Translator



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Communications breakthrough

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With this new electronic message switching system, the FAA effects a major advance in the speed, scope and flexibility of its weather communication service—which supports all civil and extensive military aviation in the United States.

Nucleus of the system is a series of five Interchange Centers, located in Kansas City, Cleveland, Atlanta, Fort Worth and San Francisco. Each of these acts as a clearing house for a number of area circuits, or outlying "loops," collecting data from observation points on these loops and providing the area circuits with data from other parts of the country.

Teletype electronic communications equipment at the Interchange Centers carries out an automatic program of sequentially calling data-originating stations, classifying messages by priority, selecting only those weather items wanted at regional stations, and delivering them to the area circuits—all the while maintaining the ability to handle emergency traffic when required.

Ultra-fast communication between Interchange Centers is provided by Teletype punched tape equipment operating at 850 words per minute, utilizing the Data-Phone concept. Stations on outlying loops are equipped with Teletype Model 28 page printer and punched tape units. Speed-conversion equipment permits automatic interoperation between the national circuit and the local loops. Thus the new system, which serves some 2,400 locations, can report weather conditions from any part of the country in a matter of minutes.

The FAA, through the years, has followed a program of continually upgrading its facilities to meet the needs of the nation's growing air traffic. Teletype Corporation is proud of its part in providing communications equipment for this vital service.

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aircraft readiness display board which may be composed entirely of electroluminescent numerics. Squadrons could report their status in the past, present and what is anticipated in the near future. The information could be readily coded to show unfulfilled commitments in numbers of aircraft as well as a record that would show how these commitments were met. There could be also a record of alert status indicated by color bars at the side of the display. The status of traffic in a communications net could be displayed. A large world map and a smaller area map could display qualitatively the traffic load condition of the various trunks by colored lines between stations in the net. Detailed quantitative information could be displayed on tabular boards of alphanumeric characters at the sides of the map. These large displays may be set up in any desired fashion in a room chosen to suit the employer since these are flat panel displays that require no space in front or rear for a projector.

The electroluminescent system may be used to display tracks, lines or pictures rather than digital characters. One means of providing such displays is by cross-gridding the electroluminescent phosphor layer. This device is most useful in a large plotting board for following a high-speed track. The device is especially useful for retaining the digital accuracy of data processing equipment since the position of the lighted element on the panel is determined by printed leads on the panel rather than by accurately adjusting the value of an electrical potential. In some cases storage is desired. This may be performed by employing photoconductive layers. The display board is triggered by a fine spot of light and retains the image as it is scribed. It may be modified for use with a cross-grid electroluminescent panel to permit electrical rather than optical access.

Finally, in display we require a solid-stage image panel which is analogous to a cathode-ray tube where high speed access to a large number of elements is required. This we can do by employing a piezoelectric ceramic panel. A light spot can be obtained on any part of the superimposed electroluminescent phosphor layer by launching sound waves from edge electrodes. As another example, the panel could be operated as a solid-state oscilloscope to display a Lissajous pattern. Applications for a variety of military display devices come to mind.

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Bendix Systems Division, The Bendix Corp.
Bliley Electric Co.
Bruno-New York Industries Corp.
Budd Electronics, Inc.
Burroughs Corp.
California Water & Telephone Co.
Cambridge Thermionic Corp.
Capitol Radio Engineering Institute, Inc.
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Chesapeake & Potomac Tel. Co., The
Cincinnati & Suburban Bell Tel. Co., The
Collins Radio Co.
Comptometer Corp.
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Convair/Pomona, Convair Division of General Dynamics Corp.
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Cornell-Dubilier Electric Corp.
A. C. Cossor Ltd.
Craig Systems, Inc.
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DuKane Corp.

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Hazeltine Electronics Division, Hazeltine Corp.
Heinemann Electric Co.
Hoffman Electronics Corp., Military Products Div.
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Hughes Aircraft Co.
I. D. Precision Components Corp.
ITT Europe
Illinois Bell Telephone Co.
Indiana Bell Telephone Co., Inc.
Ingersoll Products, Div. of Borg-Warner Corp.
Institute of Radio Engineers
Instruments for Industry, Inc.
International Business Machines Corp.
International Resistance Co.
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Materiel Telephonique, Le
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Montgomery Co., The
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Northrop Corporation
Northwestern Bell Telephone Co.
Oak Manufacturing Co.
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Orbit Industries, Inc.

Pacific Telephone & Telegraph Co., The
Packard-Bell Electronics Corp.
Page Communications Engineers, Inc.
Pan American World Airways, Inc.
Paraplegics Manufacturing Co., Inc.
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Teletype Corp.
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T.M.C. (Canada) Ltd.
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Union Carbide Corp.
United Telephone Co. of Missouri
United Transformer Corp.
Varian Associates
Vitro Electronics, Division of Vitro Corporation of America
Waterman Products Co., Inc.
Webcor, Inc., Electronics Division
West Coast Telephone Co.
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Westinghouse Electric Corp.
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Association affairs

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CHAPTERS AT LARGE

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Chapter News

REGION A

Lexington-Concord

The chapter held a luncheon May 26 at the Carriage House in Lexington. The Honorable Leverett Saltonstall, senior senator from Massachusetts, addressed the gathering of 235 military and industrial representatives from Boston's "Golden Electronics Semi-Circle." He spoke on "Our National Defense Posture."

Among the notable members of the chapter present were: Major General Kenneth P. Bergquist, USAF; Major Edwin Schaad, USA; John H. Carter, ITEK Corp; Richard Osgood, Sylvania Electronics Systems; Dr. Martin Schilling, Raytheon Co.

Chapter President Lieutenant Colonel Donald V. Mayer, USAF, announced the results of the April election of officers for 1961-62. Those elected were: president, George Twigg, III, Raytheon Co.; executive vice president, Colonel Harry A. Wilson, USAF, Electronic Systems Division; vice president, membership, Grady Holt, General Dynamics Corp.; vice president, education, Colonel Robert Lynch, USAF, Electronic Systems Division; vice president, programs, Thomas Longtine, Raytheon Co.; secretary, William Thresher, Radiation, Inc.; treasurer, Milton Gould, MITRE Corp.

Joseph W. Stehn, director, Military Sales, Maxson Electronics Corp., received a group member certificate for the Maxson Corp., at the meeting.

Senator Saltonstall told the group that the "primary purpose of America's military might is peace, not war" and that the United States, in her combined strategic-tactical force "remains the strongest nation in the world militarily."

He said that the new Administration's defense budget emphasized "a pick-up in limited war capability and long-range view in strategic missileery, speeding up the Polaris and Minuteman—the second-strike weapons designed to survive enemy attack." The Senator said, "President Kennedy and Secretary McNamara in their speeches and presentations to Congress have emphasized repeatedly that American military preparedness is dedicated to peace rather than war and will not be used except in retaliation of an attack by an enemy. This continues the policy of the Eisenhower Administration."

REGION C

Cape Canaveral

A meeting of the board of directors and officers was held June 2 at the Officers Club, Patrick AFB.

A luncheon meeting was held June 22, also at the Officers Club, Patrick AFB. Thirty-four members and guests attended. Chapter President Meredith

reported on his trip to the 15th Annual AFCEA Convention in Washington. He appointed Joe Harris to fill a vacancy on the board of directors.

Gulf Coast

A dinner meeting was held June 5 at the Airmen's Club, Keesler AFB. There were 84 members and guests attending. Guest speaker Eugene A. Klein presented a technical paper on "A Dot Component Packaging System for Electronics."

Mr. Klein was with the Glidden Company from 1949 to 1954, during which time he secured 10 patents and now has 12 others pending. He is now with Hughes and is conducting research related to electronic packaging, etched and printed circuitry, insulation resistance and electroplating.

North Carolina

A dinner meeting and dance was held May 30 in the Lafayette Room of the Fort Bragg Officers Open Mess with 104 members and guests attending. Major General T. S. Conway, Commanding General, 82nd Airborne Division, Fort Bragg, and Mrs. Conway were among the special guests present.

The following officers were elected for the year 1961: president, Colonel Paul Van Sloun, Signal Officer, XVIII Airborne Corps, Fort Bragg; first vice president, Edwin A. Clement, assistant vice president, Southern Bell Tel. & Tel. Co.; second vice president, Don J. Lloyd, American Tel. & Tel. Co.; secretary-treasurer, Harold N. Simpson, Carolina Tel. & Tel. Co.; national committee member, J. F. Havens, Carolina Tel. & Tel. Co.

Directors of the chapter are: H. D. Holderness, president, Carolina Tel. & Tel. Co.; Major General T. S. Conway; H. E. Hussey, president, General Telephone Co., Southeast; F. E. Henderson, assistant vice president Western Electric Co., Inc.; Harry Y. Alexander, general commercial manager, Southern Bell Tel. & Tel. Co.

Mrs. Ethel Casey, soloist from Raleigh, N.C., presented entertainment for the evening.

Northwest Florida

A dinner meeting was held May 26 at the Coronado Motor Hotel, Fort Walton Beach, Florida, with 43 members and wives and guests attending. Special guests were E. C. Wimberly, president, Playground Area Chamber of Commerce, and Mrs. Wimberly, and guest speaker H. C. Taylor, Burroughs Corporation.

Captain William E. Shine was elected secretary-treasurer, replacing Major Norman E. Zelinski.

Mr. Taylor presented a talk on "Advances in the Field of Computation." He described the old digital computer

program of the past, and pointed out the advances in computer design and utility for the future. He said old time computers only do "exactly as they are told," however, computers for the future can be expected to "think for themselves." He showed miniature proto-type computer building blocks designed by Burroughs which show great promise in advancing the "state-of-the-art" of computer design in support of our national security.

As We Go To Press

National Headquarters has received word of the organizational meeting of the Redstone-Tennessee Valley Chapter.

REGION F

Greater Los Angeles

The chapter elected officers for 1961-62 at the May 24 dinner meeting. Those elected are: president, Colonel John W. Atwood, SigC, USAR, Hughes Aircraft; first vice president, Lieutenant Commander Ray E. Meyers, USN (Ret.); second vice president, Lieutenant Commander Clay Bailey, Convair-Pomona; secretary, J. H. Goodrich, Pacific Telephone; treasurer, Jay DeBeau, RCA, West Coast Missile & Surface Radar Division.

Directors are: 1964, Richard Green, Collins Radio; Lieutenant Colonel Neal A. Jolley, Gilfillan Brothers; C. E. Kirk, Jr., Glenair, Inc.; Colonel Glenn S. Meader, USA (Ret.); 1963, John W. Inwood, Western Union Telegraph Co.; Captain John K. Knight, USNR, National Broadcasting Co.; James G. Russell, Librascope, Inc.; David G. Soergel, North American Aviation, Inc.

Eighty-one members and guests attended the annual meeting held at the Statler Hilton Hotel.

Sacramento

A meeting was held May 18 with 31 members and guests present. The following officers were elected: president, Roy C. Berner, Pacific Telephone & Telegraph Co.; vice president, William R. Klauer, Neeley Enterprises; secretary-treasurer, Miss Ethel Klusman, GEEIA, McClellan Air Force Base.

Following the election of officers G. W. Storey, Western Region GEEIA, addressed the chapter. He discussed the history and development of GEEIA, and the scope of operations which cover the 8 western states and Alaska.

The July 13 meeting was held at the Telephone Company main office in Sacramento. Speaker was J. W. Hull, vice president and general manager of Northern Counties Area, Pacific Telephone and Telegraph Company. Following dinner and the talk members were conducted on a tour of the facilities.



Chicago—(Photo left) At the May meeting: (L to R) guest speaker Captain E. L. Beach, USN, Commanding Officer, *USS Triton*; host Captain R. H. Northwood, Supply Corps, USN, Commanding Officer, U. S. Naval Electronics Supply Office, Great Lakes; chapter president W. L. McGuire, Automatic Electric Co. (photo right) **Paris**—Chapter president Major General F. W. Moorman (right) presents a group member certificate to Le Materiel Telephonique represented by Philippe Lizon (center) and General Combaux (left).



Augusta-Ft. Gordon—(photo left) Curt Huff and his mother hold certificate presented by chapter president Col. T. J. Trainor, (right) at the June 15 meeting. Curt, who graduated from North Augusta High School this year, was named the winner of the chapter's \$300 1961 science scholarship. (photo right) **Greater Los Angeles**—At the May 24 meeting: (L to R) guest speaker Capt. W. G. Jackson, Jr., USN, commanding officer, Office of Naval Research; chapter president John W. Atwood; Miss Pat McCarthy; Robert G. Mahan, NROTC, University of Southern California, AFCEA Gold Medal Award winner.



North Carolina—(Photo left) New chapter officers with past president J. F. Havans (second from left), (L to R) E. A. Clement, first vice president; Col. P. Van Sloun, president; D. J. Lloyd, second vice president. (photo right) **Arizona**—Scientific contest winners (L to R) Denis Kodimer, Doug Keene, chapter president Col. C. D. Harding, Jeff Patrick, John Voigts.

EUROPEAN REGION

Paris

The chapter held a dinner meeting June 13 at the SHAPE Officers Lounge. Guest speaker was George Goudet, Professeur a l'Ecole Supérieure de Physique-Chimie Industrielles and Directeur du Laboratoire Central de Telecommunications.

The following new officers for 1961-62 were announced: president, Rear Admiral Theodore A. Torgerson; first vice president, Major General Frank W. Moorman; second vice president, A. de Bondini; third vice president, Colonel Leon J. D. Rouge; honorary vice presidents, Dr. Maurice E. Deloraine, General J. M. H. Guerin, Maurice Jean, Ing. General Charles Marzin, Dr. Maurice Ponte, G. Rabuteau.

Directors of the chapters are: Henri M. Angles D'Auriac, Roger A. Aubert, Lieutenant Colonel T. T. Jacques L. Debre, Marc A. de Ferranti, Colonel Arien H. de Goede, Rear Admiral Eugene J. Giboin, Louis Henry, Marcel V. Laveran, Joseph R. Pernice, Maurice Vidrequin.

Professor Goudet presented a talk on Coherent Light which covered the evolution of ideas upon the mechanisms of the emission of light and the research work which led to demonstrate the existence of the phenomenon of stimulated emissions. This phenomenon can be used for the realization of light sources, or coherent sources, the directivity and intensity of which were unknown up to now. Such sources were

described and their possible applications to communications were discussed.

PACIFIC REGION

Hawaii

Seventy-one members and guests attended a luncheon meeting held May 18 at the Hickam AFB Officers Club. Special guests were Major General Earle F. Cook, USA, Deputy Chief Signal Officer, Brigadier General John C. Monahan, Signal Officer EUSA, Leonard D. Callahan, AFCEA director.

Chapter president Simpson announced the winners of the chapter awards given at the Fourth annual Hawaii Science Fair. The winners were: 1st place, Galen Aoki, Honolulu, for Computer-Mite-Y-Kohuna II, awarded Volt Ohmmeter Kit; 2nd place, William Lynd, Honolulu, for Ultrasonic cleaner, awarded, Electronic Voltmeter Kit; 3rd place, Glen Murakami, Hilo, for Electro-Static Machine, 75,000 Volt Atom Smasher, awarded Radio Broadcasting Station Kit.

General Cook spoke on "The Signal Corps Contribution to Limited Warfare Capability." His speech was highlighted by a 30-minute color film covering the most recent research and development items being produced by the Signal Corps Research and Development Laboratories at Fort Monmouth.

Okinawa

The meeting May 2 was sponsored by the Air Force 1962nd AACCS Group.

Special guests were Major General John R. Sutherland, Commanding General, 313th Air Division, and guest speaker Major General Earle F. Cook, USA, Deputy Chief Signal Officer.

General Cook presented a talk on the progress of Signal Corps equipment development through the past year and showed a film prepared by the Signal Laboratories on new equipment development.

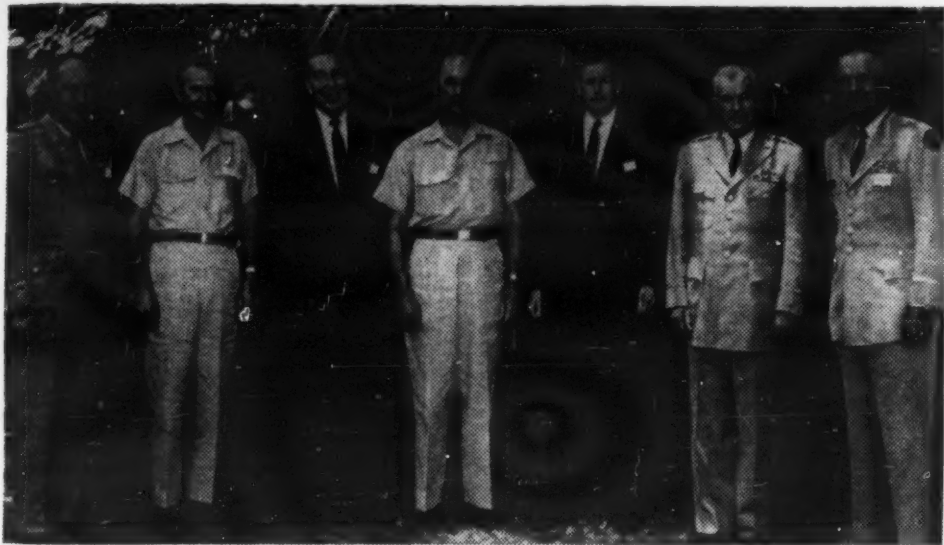
CHAPTERS AT LARGE

Puerto Rico

The regular monthly meeting of the chapter was held May 18 at the Fort Brooke Officers Club. Special guests included Edward Kelly, AT&T, Frank Arrellito, Radio Corporation of Puerto Rico, Ray Barrett, Northern T&T, Mr. Atkins, Western Electric Co., Martin Diaz, Radio Corporation of Puerto Rico, Charles LaVergne, Morgan Safe Company.

Joaquin Gandia, FAA, was elected to fill a vacancy in the board of directors.

Chapter president Walter Siddall gave a preliminary discussion on TASI, the newest method of obtaining 100% more utilization of a 4-wire telephone system. TASI is an abbreviation for Time Assignment Speech Interpolation system. Carlos Santiago, engineer, Radiotelephone Corporation of Puerto Rico, gave a demonstration and explanation of the operation of TASI.



Hawaii—Taken at the May 18 meeting at Hickam AFB (L to R) Col. W. A. Simpson, president chapter; Brig. Gen. B. M. Wooton, L. D. Callahan, AFCEA director; Lt. Gen. G. Blake, regional vice president, Pacific Area; guest speaker Maj. Gen. E. F. Cook, USA; Brig. Gen. J. C. Monahan; Brig. Gen. S. S. Hoff.



Lexington-Concord—At the May 26 meeting: (L to R) O. Auchingloss, Tracerlabs; G. Twigg, vice president, programs; Senator Leverett Saltonstall, senior senator, Massachusetts, guest speaker; Lt. Col. D. V. Mayer, chapter president; Maj. Gen. K. P. Bergquist; J. W. Stehn, Maxson Electronics Corp.

Association News

Convention Summary

Frank A. Gunther, president of Radio Engineering Laboratories, Inc., was elected national president of AFCEA at the 15th Annual Convention, June 6, 7, 8. Also newly elected was John R. O'Brien, Hoffman Electronics Corp., as national treasurer. Reappointed were Colonel W. J. Baird, as general manager and editor, and Colonel Frank T. Ostenberg, as secretary, National Headquarters. Frank W. Wozencraft was

reelected as general counsel.

A complete list of all national officers and directors, including those newly elected, appears on page 79.

A resolution expressing the Association's thanks and appreciation to Benjamin H. Oliver, Jr., for his executive leadership and guidance during his two year presidency was passed unanimously at the Council meeting. Special thanks were also extended to Earl Trantham and Frank W. Wozencraft for

outstanding service rendered to the Association as treasurer and general counsel respectively. A special citation certificate will be issued to these distinguished gentlemen.

A meeting of regional vice presidents and chapter presidents was held June 6 at which reports were presented on chapter activities. Regional vice presidents making presentations were: W. K. Mosley, Region C, (Building Memberships and New Chapters);

Walter H. Pagenkopf, Region E, (Chapter Programs and Special Projects); Lieutenant Commander Ray E. Meyers, USN (Ret.), Region F. (Financing Chapter Activities); Brigadier General Kenneth F. Zitzman, USA (Ret.), European Region, (Overseas Chapter Activity).

Introductory remarks were made by Colonel W. J. Baird, and closing remarks by national president Benjamin H. Oliver, Jr. A question and answer period followed the regional vice presidents' presentations. The coordinated schedule was well received by all present.

The unofficial attendance figure at the Convention is estimated at 6,000. National Headquarters is proud to state that our official count indicated 4,306 registered to see the exhibits. This count does not include the ladies or invited social guests.

Attendance at the social events broke all previous records. Over 500 attended the Keynote and Industrial Luncheons, with over 1400 at the Banquet. The popular Buffet and Floor Show, which is handled by John Gilbarte, Continental Consultants, also drew 1400 guests. Fifteen table reservations have already been received for the Buffet and Floor Show and for the Banquet at the 16th Annual Convention next year. This is undoubtedly an indication of the enthusiastic interest and satisfaction of this year's Convention and Exhibit.

AFCEA Distinguished Service Awards

The Armed Forces Communications and Electronics Association Distinguished Service Award was presented to ten national directors and past presidents of the Association during an impressive ceremony at the 15th Annual Convention. In addition, Major General R. T. Nelson, present Chief Signal Officer, USA, presented the Distinguished Service Award to Major General Harry C. Ingles, a former Chief Signal Officer in World War II, and the recognized founder of AFCEA.

General Ingles in turn made presentations to: Frederick R. Lack, Theodore S. Gary, William J. Halligan, Brigadier General W. W. Watts, Rear Admiral Joseph R. Redman, Dr. George W. Bailey, Colonel Percy G. Black, Rear Admiral Frederick R. Furth, Benjamin H. Oliver, Jr.

Mr. Oliver expressed thanks and appreciation for the award winners and also accepted the award for Brigadier General David Sarnoff, first president of AFCEA, who was not able to attend due to a previous engagement.

The Citation reads: "The Armed Forces Communications and Electronics Association is honored to present this award in recognition of distinguished service to the Association, for outstanding executive leadership and professional guidance which have contributed to the strengthening of the civilian military team effort in communications and electronics for a stronger National security."

In Memoriam

National Headquarters regrets reporting the recent death of P. C. Canning, Plessey Co., Ltd. He had been a member of the London chapter since 1954 and served as associate treasurer, associate vice president and a member of the executive committee.

Honorary Member

By unanimous vote of the Council during the 15th Annual Convention, former president General Dwight D. Eisenhower was voted an honorary membership in the Association. A suitable certificate and medal will be presented subject to General Eisenhower's acceptance.

General Dreyfus Retires

The Association extends its congratulations to Major General James Dreyfus for the outstanding services which he has rendered to his country in many positions of great responsibility during his military career. We feel his retirement from the military service on June 30, 1961 to be a loss to the military but a gain to industry. The entire Association extends its best wishes for future and continuing success.

Wheaton Engineering Division Joins Association

Wheaton Engineering Division of Hurltron, Inc. has joined the Association as a group member. The company is located in Wheaton, Illinois. J. A. Reinhardt, general manager, has been appointed representative to the Association.

Others named to membership are: J. A. Reinhardt, Jr., sales manager; Robert Emlander, vice president; Jim Hoekje, chief engineer; William Stillwell, works manager; James Tatum, chief electronics engineer; Russ Neff, assistant sales manager; E. R. Husleberg, superintendent of electronic manufacturing; I. D. Byers, superintendent of mechanical manufacturing; Frank McCarthy.

AFCEA Golf Tournament at Lexington-Concord

One hundred and forty-four AFCEA golf enthusiasts from the Rome-Utica,

New York, Boston, Washington and Lexington-Concord chapters competed for the championship and trophy in the AFCEA Golf Tournament. The event was held June 15 at the Wachusett Country Club, West Boylston, Mass.

The pros, duffers and weekend golfers played according to a revised Calloway System which established each golfer's handicap at the end of 18 holes. The trophy, however, was awarded on a true score basis. One member of each foursome won three golf balls for the closest drive to the pin on the first hole, a par three. Colonel Frank Lux, USAF, Lexington-Concord chapter, won a putter for the closest drive on the seventh hole, a 275 yard drive. A prize was also awarded for the highest score of the day.

The awards banquet began at 6 p.m. Following dinner, it was announced that Pete Barry of Maxson, Sqd. Leader Mel Cummings, RCAF, and Tommy Longtine of Raytheon, were tied for the championship with scores of 83.

On June 22 the three golfers met at the Concord Country Club, Concord, Mass, for a play-off. Over 60 AFCEA members attended to watch.

From the start, the game was close. At the end of the eighth hole all were tied. At the end of the first nine the scores were 46, 46, 47, with Cummings and Barry tied. On the 12th hole Pete Barry drove and lost a ball out of bounds with a bad slice. He fell behind Cummings and Longtine with Cummings leading 57, 58, 61. Barry was never able to recover those three strokes.

At the end of the 17th hole, Cummings and Longtine were tied 84-84. Barry had 88. It appeared another tie might exist. The 18th hole was a par 4 with a wide fairway. The two men had good drives and approaches. Both had a lie of 2 on the green. Longtine had a 20 foot putt to sink, while Cummings measured 18 feet to the cup. It took two putts for Longtine to sink the ball, and his final score was 88. Cummings was four feet from the cup after his first putt. On the second putt the ball stopped within an inch of the cup. Final scores—Barry, 92, Cummings, 89 and the winner, Longtine with an 88.

Listing of new members of AFCEA who joined during the months of June & July will appear in September.

Finalists in the Lexington-Concord Golf Tournament with chapter president Lt. Col. D. V. Mayer, (L to R) Sqd. Leader Mel Cummings, RCAF, Thomas Longtine, Col. Mayer, Pete Barry.



AFCEA SERVICE ACADEMY AWARDS

AFCEA Service Academy Awards for outstanding graduates in Electronics were Trans-Solar portable radios donated by Hoffman Electronics Corporation. 1961 winners also received a year membership in the Association.



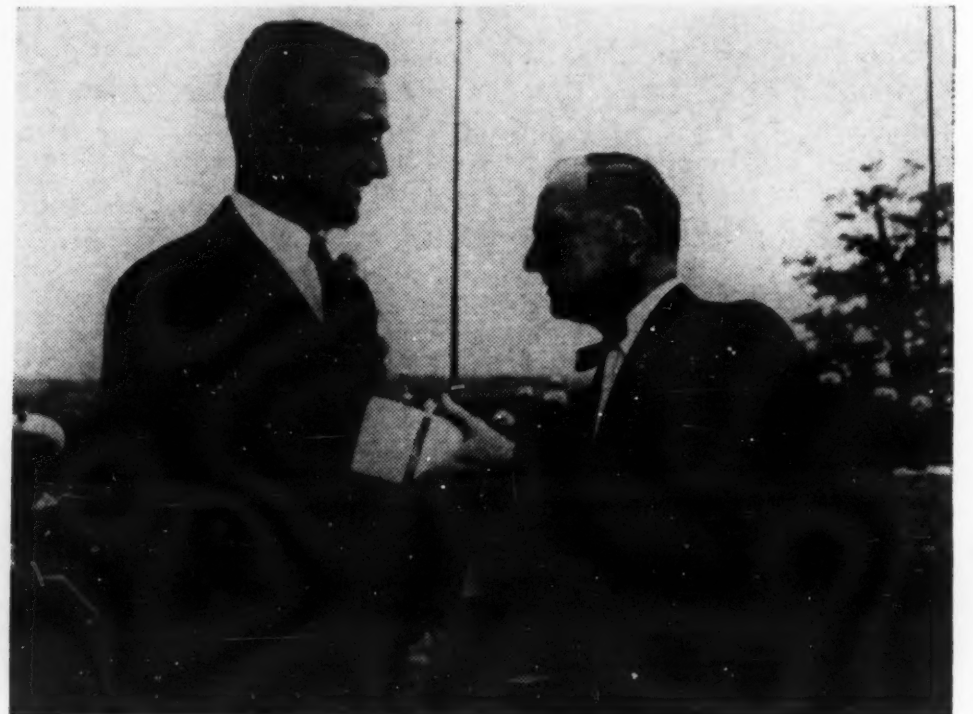
Col. W. M. Lauterback, USA, presenting the award to West Point Cadet John M. Dorr.



RAdm. J. F. Davidson, Superintendent of the U. S. Naval Academy, presents the award to Ensign Richard Michael Butrovich.

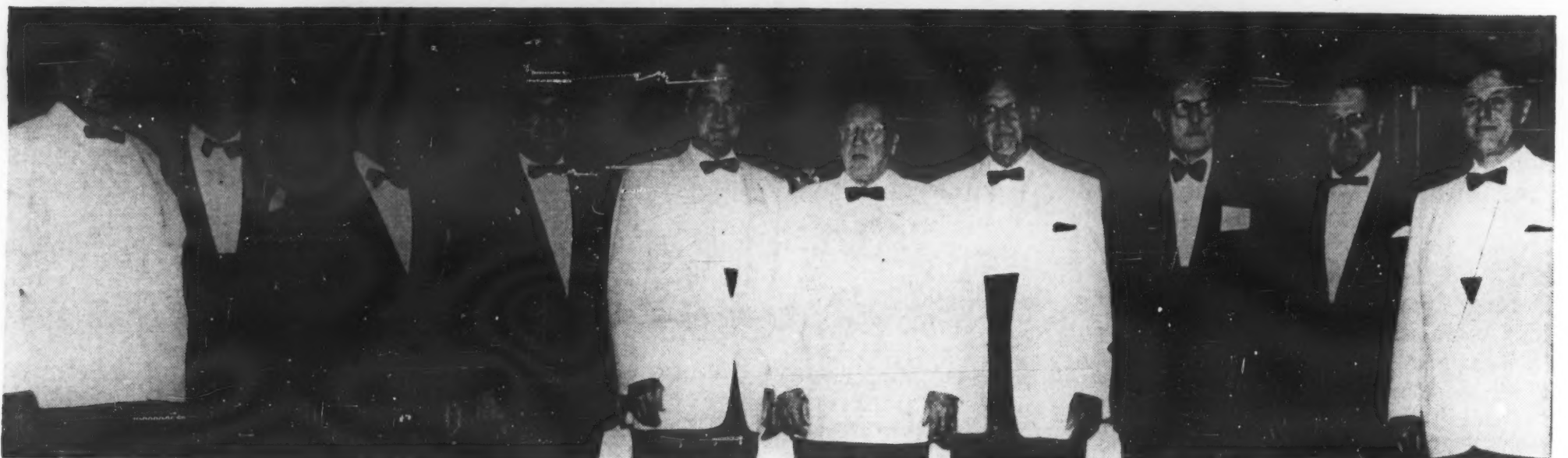


Air Force Cadet John D. Sullivan, Jr., receives his award from Maj. Gen. Harold W. Grant, USAF.



Louis Dunham of the Boston chapter presents the award to Coast Guard Cadet Donald A. Feldman.

AFCEA DISTINGUISHED SERVICE AWARDS



AFCEA Distinguished Service Award Winners—(L to R) Frederick R. Lack, Theodore S. Gary, William J. Halligan, Brig. Gen. W. W. Watts, RAdm. Joseph Redman, Maj. Gen. H. E. Ingles, Dr. G. W. Bailey, Col. P. G. Black, RAdm. F. R. Furth, B. H. Oliver, Jr., Brig. Gen. D. Sarnoff also received the award.

Electronic News Photo

AFCEA's New Officials for 1962

President

Frank A. Gunther*
President
Radio Engineering Laboratories, Inc.

1st Vice President

Major General Ralph T. Nelson*
Chief Signal Officer, USA

2nd Vice President

Rear Admiral Frank Virden, USN*
Director, Naval Communications

3rd Vice President

Major General John B. Bestic, USAF*
Director of Telecommunications

4th Vice President

Walter H. Pagenkopf*
Vice President, Manufacture
Teletype Corp.

5th Vice President

Peter J. Schenk*
Executive Vice President
MITRE Corporation

General Manager

W. J. Baird
National Headquarters

Secretary

Frank T. Ostenberg
National Headquarters

General Counsel

Frank W. Wozencraft
Attorney at Law

Treasurer

John R. O'Brien
Vice President, Military Products
Hoffman Electronics Corporation

Regional Vice Presidents

Robert B. Richmond, Reg. A
Manager of New England Sales
General Radio Company

George C. Ruehl, Jr., Reg. B-1
President
Electronic Aids, Inc.

Paul H. Clark, Reg. B-2
Manager, Dayton Office
Radio Corporation of America

W. Kelly Mosley, Reg. C
Assistant Vice President
Southern Bell Tel & Tel Co.

Harry Reichelderfer, Reg. D
Assistant Director
Southwest Research Institute

Walter H. Pagenkopf, Reg. E
Vice President, Manufacture
Teletype Corp.

Ray E. Myers, Reg. F
Consultant
San Gabriel, Calif.

Kenneth F. Zitzman
European Area
Executive Vice President
International Standard Engineering, Inc.

Brig. Gen. Douglas Williams, USAF
Pacific Area
Asst. Chief of Staff, J6
Staff, CINCPAC

Directors

1962

Theodore L. Bartlett
Manager, Special Aviation
Projects, Defense Electronics,
RCA

Lt. Gen. Gordon A. Blake
USAF
Chief of Staff
Hqs., Pacific Air Force

Ben S. Gilmer
President
Southern Bell Tel & Tel Co.

Joseph E. Heinrich
Staff Supervisor, Long Lines
Dept.
American Tel & Tel Co.

John R. Howland
Sales Manager
Closed Circuit Division
Philco Corp.

Fred E. Moran
District Manager, Boston
Western Union Telegraph Co.

Donald C. Power
Chairman of the Board
General Telephone & Electronics
Corp.

Stephen H. Simpson
Assistant to the Vice President
Southwest Research Institute

1963

Leonard D. Callahan
Vice President
Gilfillan Bros., Inc.

A. F. Cassevant
Vice President and General
Manager
Systems Engineering Div.
Kellogg Switchboard & Supply
Co.

Walter C. Hasselhorn
President
Cook Electric Co.

Walter P. Marshall
President
Western Union Telegraph Co.

Henry J. McDonald
Secretary & General Counsel
Kellogg Switchboard & Supply
Co.

A. L. Pachynski
Director of Program Planning
Lenkurt Electric Co.

William L. Roberts
R & D Liaison Officer
Ramo-Wooldridge, Div.
Thompson Ramo Wooldridge
Inc.

Ellery W. Stone
Chairman of the Board
American Cable & Radio Corp.

1964

Francis L. Ankenbrandt
Administrator, Global
Communications Program
Defense Electronics, RCA

W. Preston Corderman
Executive Vice President
Westrex Corp.

E. U. DaParma
Executive Vice President
Sperry Gyroscope Co.

George L. Haller
Vice President and Manager
Defense Electronics Div.
General Electric Co.

Charles F. Horne
Vice President and Manager
Convair-Pomona, Convair Div.
General Dynamics Corp.

David R. Hull
Former Vice President
Raytheon Co.

John W. Inwood
District Manager
Western Union Telegraph Co.

Walter K. MacAdam
Vice President
American Tel & Tel Co.

1965

George I. Back*
Assistant to the President
International Resistance Co.

Victor A. Conrad
Assistant to the President
Varian Associates

Roland C. Davies*
Editor and Publisher
Telecommunications Reports

E. K. Foster
Vice President
Bendix Corp.

Thomas F. McMains
Vice Pres. & Asst. to President
Western Union Telegraph Co.

Paul S. Mirabito
General Manager
Defense Contracts Div.
Burroughs Corp.

Pinckney B. Reed
Division Vice President
Electronic Data Processing Div.
Radio Corporation of America

Robert C. Sprague
Chairman of the Board
Sprague Electric Co.

Permanent Directors

David Sarnoff
Chairman of the Board
Radio Corporation of America

Frederick R. Lack
Former Vice President
Western Electric Co.

Theodore S. Gary
Vice President
General Telephone & Elec-
tronics Corp.

William J. Halligan
Chairman of the Board
The Hallicrafters Co.

W. Walter Watts
Group Executive Vice President
Radio Corporation of America

Joseph R. Redman
Communications Consultant
Western Union Telegraph Co.

George W. Bailey
Executive Secretary
Institute of Radio Engineers
Percy G. Black
Vice President
General Telephone Service Corp.
Frederick R. Furth
Vice President
International Tel & Tel Corp.
Benjamin H. Oliver, Jr.*
Vice President, Upstate
New York Telephone Company

*Member of Executive Committee

NEWS ITEMS AND NEW PRODUCTS

Shipments of electronic components by U.S. manufacturers in 1960 had an estimated value of \$3.4 billion, the Electronics Division, Business and Defense Services Administration, U.S. Department of Commerce has reported.

The Division said that the level of shipments was more than 10 percent above that for 1959, and that almost 40 percent of the principal components on which data were collected were for military end-use.

The annual totals show that shipments of semiconductor devices reached \$542 million in 1960, up 37 percent from \$395 million in 1959. Increases were shown also by most other categories of components, although receiving-tube output declined 7 percent from \$374 to \$348 million and output of power and special purpose tubes remained substantially unchanged at \$252 million. Shipments of television picture tubes rose nearly 8 percent to \$259 million. Capacitors gained nearly 9 percent to \$255 million and resistors about 6 percent to \$247 million.

The overall level of shipments for military uses increased about 10 percent in 1960, and nonmilitary shipments about 13 percent.

A comprehensive study of the United States' public and private money and credit system made by a group of private citizens was presented to President John F. Kennedy at the White House last June.

The result of three years of study by the privately financed Commission on Money and Credit, the report contained more than 80 recommendations for changes designed to improve the functioning and coordination of government and private financial institutions.

The 300-page document was presented to President Kennedy by Commission Chairman, Frazar B. Wilde, Chairman, Connecticut General Life Insurance Company, Hartford, Conn., and other members of the 25-man Commission. The President received the first printed copy of the report, entitled *Money and Credit: Their Influence on Jobs, Prices and Growth*.

The Commission on Money and Credit was established in 1957 as an independent organization by the Com-

mittee for Economic Development. Financial support, amounting to \$1,300,000 was furnished by the Ford Foundation, the Merrill Foundation and the Committee for Economic Development.

The Committee for Economic Development is composed of 200 leading businessmen and educators. CED, designed to provide businessmen with an opportunity to demonstrate their concern for the general welfare, endeavors to develop policy statements and other research products that commend themselves as guides to public and business policy.

The domestic communications operating industry of the United States, which includes both telephone and telegraph service, spent approximately \$182 million in its 1960 building construction program, an increase of about \$7 million over the 1959 figure, the Business and Defense Services Administration, U. S. Department of Commerce has estimated.

Based on a survey covering 127 telephone companies—94 percent of the industry—BDSA's Communications Industries Division said that the construction program, at a normal level, reflected the growing needs of the industry.

According to the survey, 75 percent of the money was used to construct buildings of the reinforced concrete type, and 15 percent for structural steel frame buildings.

The survey was made to determine the volume of materials consumed by the communications industry for building construction alone. The critical metals usage exceeds the requirements for ordinary building construction, since the communications structures usually are designed with high ceilings, and are strengthened to hold great amounts of deadweight to accommodate the equipment. The telephone industry is the user of more steel for building construction than any other single industry.

The building program required 26,099 tons of carbon steel of which 1,189 tons were steel plate. There were 12,494 tons of carbon steel used for structural steel frame buildings—including 7,749 tons of structural steel shapes and piling.

There also were 218,839 pounds of

copper and copper base alloy and brass mill products used: 1,036,301 pounds of copper wire mill products, such as copper wire and cable, for lighting and power: 65,622 pounds of copper and copper base alloy foundry products and powder. Light weight aluminum consumed totaled over 65,000 pounds. Minor amounts of stainless steel, nickel alloy and alloy steel also were required.

The National Aeronautics and Space Administration has invited four companies to submit detailed proposals on the design, development and production of the Saturn S-II stage. (See SIGNAL, May 1961, Page 103.)

The four firms are Aerojet-General Corporation, Douglas Aircraft Corporation, General Dynamics-Astronautics Division, and North American Aviation, Inc.

This is the second and final phase of a procedure to select the prime contractor for the S-II, to date, the largest rocket unit to be undertaken by U. S. Industry. The S-II will be the second stage of the advanced Saturn which will have several times the payload capability of the Saturn C-1. It will be able to lift the three man Apollo spacecraft to escape velocity and could be used for circum-lunar flight.

The S-II will be powered by four J-2 liquid hydrogen-liquid oxygen engines already under development by Rocketdyne Division of North American. The stage will have an altitude thrust of 800,000 pounds. Present plans are aimed at a target date for first flight of the advanced Saturn with the S-II in late 1964 or early 1965.

Thirty firms attended a pre-proposal conference April 18 at the NASA Marshall Space Flight Center, Huntsville, Alabama, the organization managing the Saturn project. Of the thirty, seven submitted general proposals May 11. On the basis of these proposals, four companies were selected to draft detailed proposals for building the stage.

The four firms attended a final proposal conference last June at which they were given information needed in the preparation of the proposals with regard to both technical approach and cost of the project. The

firms were given about a month to prepare their proposals. Present plans are for evaluation and negotiation to follow so that a contract can be signed by October 1, 1961.

The U.S. Army's divisions will be reorganized beginning in early 1962. The National Guard and Reserve Divisions will start their reorganization at the same time but that part of the project will be phased over a longer period of time.

At the present time, the Army has three types of divisions—Infantry, Armor and Airborne. The change provides for four types of divisions—Infantry, Armor, Airborne and a new type, Mechanized.

The present Infantry and Airborne Divisions are Pentomic in structure—an organization geared to the normal employment of tactical nuclear weapons. Each has five battle groups as the combat maneuver elements. The present Armor Division has three combat commands to which various combinations of tank and armored infantry battalions are attached as the situation demands.

The four new types of divisions will have a common division base. In each division will be three brigade headquarters. As each division is organized, it will have assigned to it varying numbers and types of battalions—Infantry, Mechanized, Tank or Parachute Infantry. The assignment of these battalions will depend on the geographic location of the division and the mission which it may be assigned or expected to be assigned.

In general, the new divisions are designed to provide: Flexible forces tailored to their environment and mission; Improved limited war capability; Improved non-nuclear firepower; Forces tailored as to tactical mobility; Mechanized forces for Europe; Separate Airborne Brigades; Improved command control and training of subordinate leaders; and, Effective use of available resources.

The Air Force has announced the discovery of what appears to be a dense band of micrometeorites which envelope the earth at extreme altitudes. The discovery was made last June by the Air Force Cambridge Research Laboratories at Laurence G. Hanscom Field, Mass., when the contents of a rocket nosecone specially designed for trapping micrometeorites at extreme altitudes was examined.

The nosecone was launched June 6 at White Sands, New Mexico. Its maximum altitude was 102 miles. The density of the micrometeorites in this

layer was totally unexpected. About 10 of these small particles struck each square centimeter of the detecting surfaces each second.

The dust particles, measured in microns, apparently exist as a band about the earth that is independent of latitude or longitude. The precise altitude at which these micrometeorites are concentrated will be determined by future tests now planned by the Air Force.

The U.S. Air Force contracts and procurement offices have been centralized into a single office at Hanscom Air Field, Massachusetts. The new office is headed by Colonel William A. Bennett, Jr., assisted by Mr. William J. Irwin. Previously, contractors had two separate offices to deal with—the Research and Development Procurement Office and the Systems Procurement Office—each under a different head.

The Research and Development contracts principally involve studies undertaken by universities and industry and include such areas of interest as the geodesy of the moon, Arctic ice studies and oceanic studies. The Systems Procurement contracts are concerned with the procurement of equipment for the various electronic systems under development by the Air Force.

The RACEP Discrete Address System, developed by the Martin Company, is a mobile radio telephone system which provides gains in spectrum efficiency, transmission reliability and operations flexibility. The system uses pauses and breaks in normal conversation and the idle time between calls by employing a voice-actuated pulse-modulation technique called RACEP (Random Access and Correlation for Extended Performance).

A single wide-band frequency channel is used by all subscribers at the same time without synchronization or programmed time sharing, thus providing random access to the transmission medium. Each information pulse is transmitted as a coded sub-pulse-group in a time-frequency matrix which provides a means of discretely addressing any single subscriber to the exclusion of all others.

Leach Corporation, Los Angeles, announces a half-sized crystal can relay, the M-250.

The relay, only .35 ounces in weight and .128 cubic inches in volume, eliminates the necessity for laying relays down horizontally, as is the case with the standard submini-

ature crystal can like the M-200, and eliminates use of hold-down tabs.

The decreased size is less sensitive to vibration forces with further advantage in lowering the center of gravity wherever it eliminates a standard-sized relay of comparable function that is mounted vertically. The relay contains a single-coil electromechanical circuit in place of the two coils in the standard subminiature crystal can.

An electronic converter for use in the programming of missiles has been developed for the Strategic Air Command by the Digitronics Corp., Albertson, N. Y. The converter will function at approximately four times the speed of previous equipment in the preparation of trajectory instructions for various types of missiles.

The Digitronics converter is all solid state and bi-directional.

General Telephone & Electronics Corporation has announced the development of a solid-state microwave transmitter for space communications. The transmitter is less than the size of a cigarette carton, occupies about one-seventh the space, has 11 times the life expectancy and ten times the frequency stability of conventional transmitters.

Developed for the Air Force, the transmitter is the first designed to operate with two watts of output power within the S-band (1700 to 2300 megacycles). These are considered to be the minimum power and frequency requirements for transmission of information between two points on the earth's surface via an active relay satellite in a stationary orbit.

The transmitter could be combined with a solid-state radio receiver developed earlier by GT&E to form a complete space communications system. The system would be used for space probes, or would be a major element in a satellite communications system.

A 16-page "Manual of Facts" on subcontract manufacturing services has been recently published by the contract manufacturing division of the Paraplegics Manufacturing Co., Inc., 304 N. York Road, Bensenville, Illinois.

Included in the manual is a five-point program for reaching a decision on whether a specific component or assembly should be built in a company's own plant or if the services of an outside contract manufacturer should be employed.

The development of a test production system to translate one language into another by means of an electronic computer at the rate of 60,000 words per hour was announced recently by Machine Translation, Inc., Washington, D. C. At a Press demonstration of the system—called the Unified Transfer System—an article from the Russian newspaper *Pravda* was translated into English at 60,000 words per hour. Part of this article was also translated into German.

Mrs. A. Lukjanow, inventor and developer of the system and President of the firm, reports the unified transfer system has been designed for use on general purpose computers and is suitable for translation of any language into any other language as long as one language is an Indo-European tongue.

The firm expects that a full production system will be ready within 12 months. At that time the translation speed will be increased to over 150,000 words per hour using the IBM 7090 computer. The system may be able to translate one million words per hour when used on IBM's new Stretch computer. The test model incorporates only 50 percent of the linguistic rules, yet produces a highly acceptable translation. The remaining linguistic rules have been prepared and will be phased into the final production system.

The unified transfer system combines the transfer of word functions, word form, word meaning and word distribution into a single transfer process. In order to achieve this transfer a classification system has been devised for each of the transfers expressed in the form of a code, which is then incorporated into unified code patterns. Machine Translation now has a computerized Russian-English dictionary of over 5,000 Russian words and their 32,000 English meanings. By mid-1962, the dictionary will have been expanded to over 50,000 Russian words and over 300,000 English meanings.

Mrs. Lukjanow stated that Machine Translation hopes to translate, print and distribute *Pravda* and other Russian newspapers in this country on the same day they are published in Russia. The addition of scientific dictionaries to this system will permit translation of the vast amounts of foreign technical material from Russian and other languages into English that at present goes untranslated or is only translated long after it has appeared. The system is expected to contribute significantly to the amount of material that will be translated in the future.

The revised report on a Common Business Oriented Language for programming electronic digital computers is now available from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

The report, COBOL-61, was made to the Conference on Data Systems Languages by a Special Task Group representing 11 computer manufacturers, the Department of Defense and other major users of computers.

COBOL-61 updates the COBOL issued in 1960, which set out the initial specifications for the Common Business Oriented Language.

Through the use of the COBOL method of programming, it is anticipated that in addition to interchanging programs among locations which use different makes and models of computers, it will be possible also to reduce the time and cost that has been involved in writing computer programs and revising such programs.

A former Navy tanker, the *USNS Mission Capistrano* (TAG-162), has been modified to carry a very high-powered sonar transducer to be used in the detection and tracking of submarines in connection with Project Artemis.

Artemis is an exploratory development effort sponsored by the Office of Naval Research to determine the feasibility of using the transducer and high-gain receivers, together with advanced data processing equipment, for locating submarines at very long range in large ocean areas.

The transducer is five stories high and weighs hundreds of tons. The *Mission Capistrano*, which has a full load displacement of 17,340 tons, is equipped to raise and lower sound source in the water and provide power for its operation. The electrical power used in the sound source would furnish lights for a town of 50,000 persons.

A tower called Argus Island has been installed 30 miles southwest of Bermuda as a relay point for hydrophones placed on the ocean floor. The tower has been erected on top of an extinct underwater volcano.

Prime contractor for the Artemis project is Hudson Laboratories of Columbia University. Some 30 university, government and industrial scientific groups in the United States are involved in the program.

This particular concept of using a very high-powered sound source combined with sensitive receivers to accomplish long-range submarine detection was proposed by Dr. Frederick V. Hunt of Harvard.

An electronic communications and information processing system for transmitting railroad freight information has been completed. The system consists of a microwave network, facsimile sending and receiving equipment, a large-scale electronic computer and a system of teletype communications.

Pioneered over the past four years by the Denver & Rio Grande Western Railroad at a cost of a million and a half dollars, the electronic system can pinpoint the location of any one of thousands of railroad cars in less than a minute after they have passed a Rio Grande microwave transmission station. It will also be used to determine earnings and control operating expenses on a daily basis.

A. B. Dick Co., Burroughs Corporation, Motorola Communications and Electronics Inc., and Western Union were responsible for development, installation and perfecting of the complete system.

Names in the News

R. P. May has joined Communication Electronics, Inc., as sales engineer.

William R. Rauth has been appointed manager of marketing, at the San Diego facilities of General Dynamics/Electronics' Military Products Division.

Lee De Forest, the "father of radio," died July 1, at the age of 87.

2nd Lt. D. J. Propps has been named director, Military Affiliate Radio System (MARS), Hq. First U. S. Army Signal Section, Governors Island, N. Y.

George A. Kennard has been promoted to general manager, Advanced Systems Division, IBM.

A. H. Sullivan, Jr., has been named director, Advanced Systems Development, Frederick Research Corp.

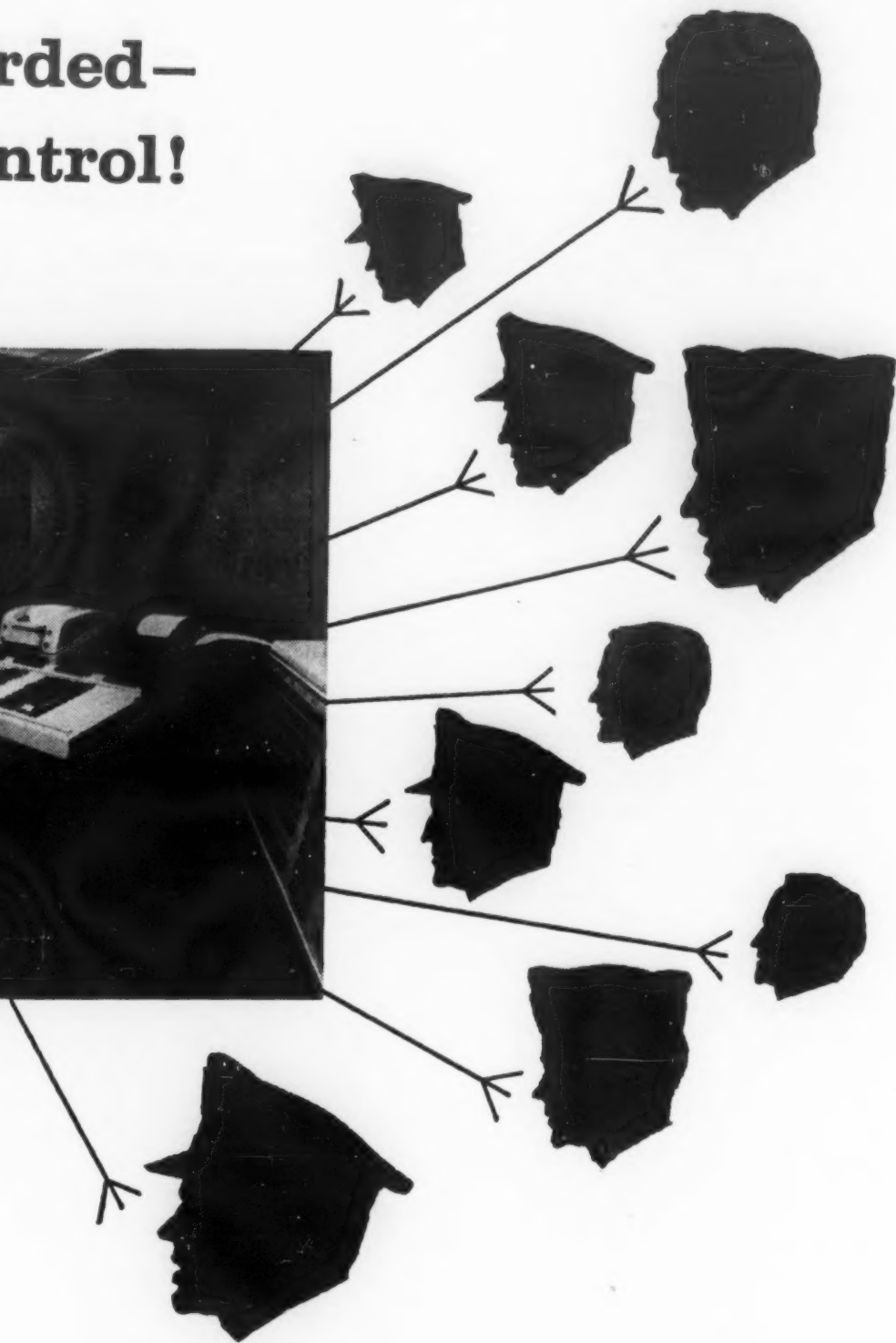
William J. LaHiff has been appointed general manager, Farmingdale Division, Dynamics Corporation of America.

Dr. Patrick Conley has been elected a vice president of Westinghouse Electric Corp.

Ashley A. Farrar has been appointed director of licensing, Raytheon Co.

Charles M. Mooney has been elected vice president, U. S. Defense Group, International Telephone and Telegraph Corp.

**Messages classified,
edited and forwarded—
with full command control!**



Honeywell's Message Distribution System rapidly routes incoming messages according to arrival time and precedence to as many as 105 terminal printers in 25 locations.

A serious limitation of a typical teletype communications system has been inefficient methods of distributing incoming messages from trunk circuits to the specific addressee. The time required to route a message at the receiving station is usually by far the largest part of the total sender-to-addressee time.

To reduce this limitation, Honeywell has applied its experience in communications techniques to develop the AN/FGC-65 Semiautomatic Teletypewriter Message Distribution System.

Developed for the U.S. Army by Honeywell's Ordnance Division, Seattle Development Laboratory, Seattle, Washington and Industrial Systems Division, Beltsville, Maryland, the AN/FGC-65 is now being installed at the U.S. Army Signal Training Center, Fort Gordon, Georgia, for test and evaluation.

A magnetic drum provides 1½ minutes of storage for initial processing. While the message is held in drum storage, the system automatically assigns a serial number and the operator reads the message to verify its content and destination. Messages with highest precedence can be transmitted to the addressee at the end of this initial storage interval.

All messages are transferred to the Transmission Tape Storage 1½ minutes after entering the system. From Transmission

Storage, previously untransmitted messages are routed to their addressees as output lines become available. Messages of high precedence will automatically interrupt lower precedence messages which are then in the process of print-out. Interrupted messages are stored within the system until the operator can instruct their retransmission.

Full disposition of every message is assured. The system shows which messages have not been fully distributed for operator intervention. In addition, the status of each output printer is displayed on the operator's console so that, in event of a malfunction, he can quickly take corrective action.

All messages are recorded on the Intercept Tape Storage, where they remain available for recall for a 48-hour period.

Thus, the Honeywell Message Distribution System assures fast and positive delivery of teletype messages while retaining the desirable element of human control.

For more information about this system, or if you would like to discuss Honeywell's communications experience in relation to a specific problem, contact your Honeywell Military Products Group representative, or, write Honeywell, Dept. SG-8-158, Minneapolis 8, Minnesota.

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SIGNAL, AUGUST, 1961

Honeywell



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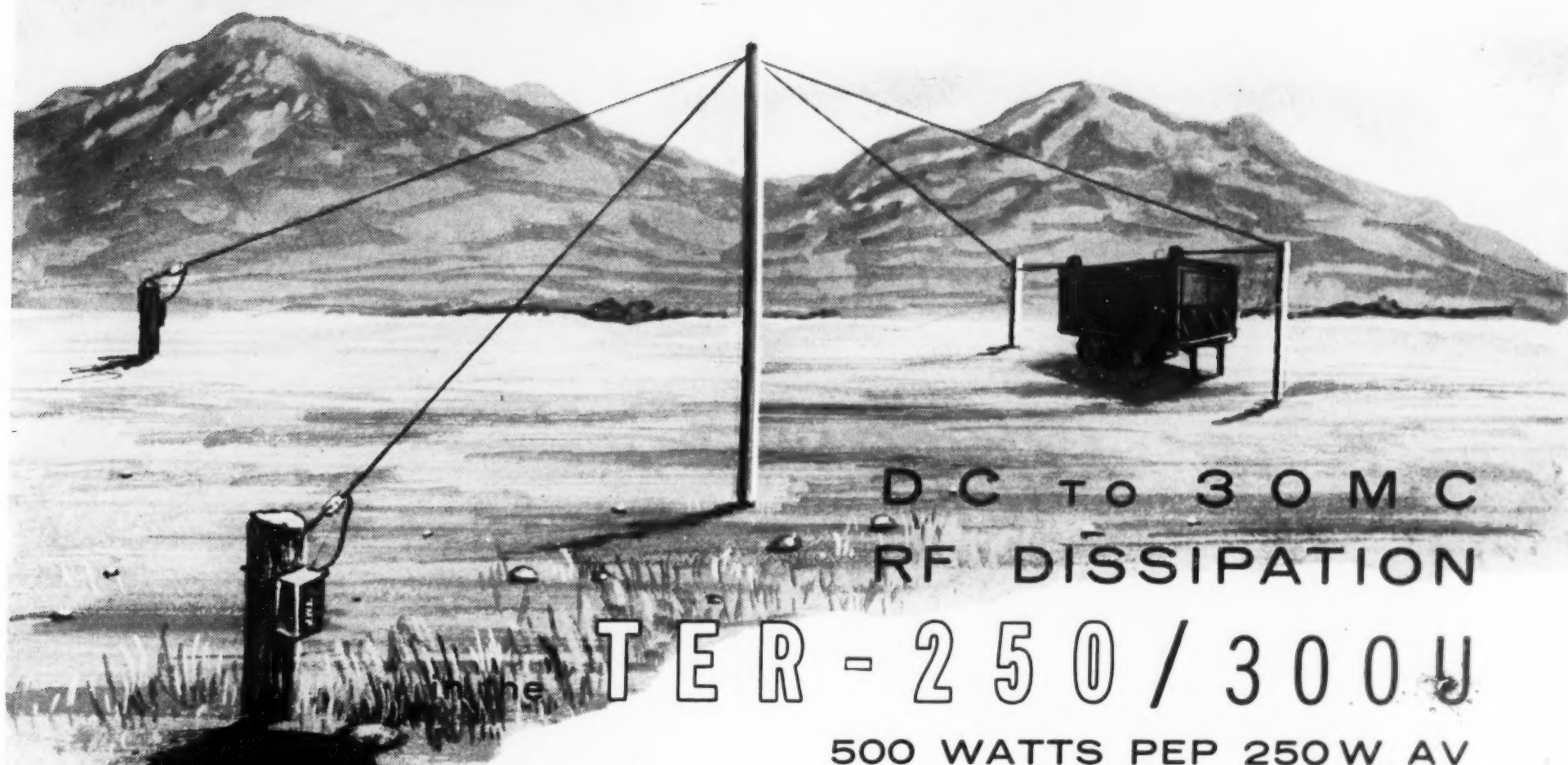
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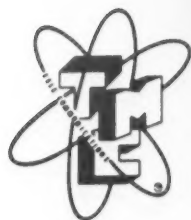
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